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EDITED BY

EDWARD W. SCRIPTURE, PH.D.

Director of the Psychological Laboratory.

Volume IX.

1901

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Researches on the rhythm of speech, by J. E. WALLACE WALLIN,	i
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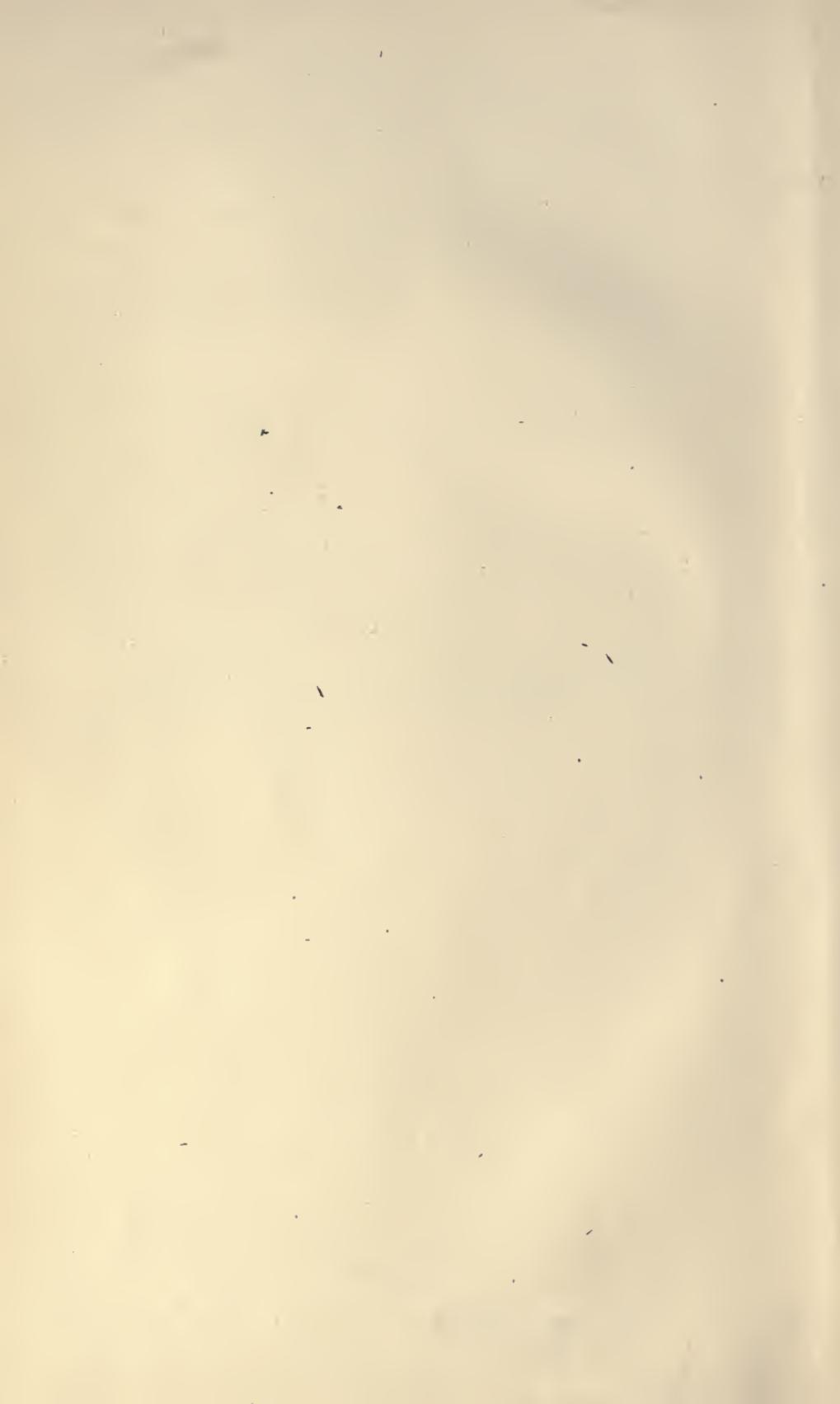
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RESEARCHES ON THE RHYTHM OF SPEECH

BY

J. E. WALLACE WALLIN.

I. HISTORICAL.

BRÜCKE¹ employed two methods in investigating the time relations of syllables and feet in verse.

In the first method the subject of the experiment beat time with the finger upon a key, in unison with the rhythm of the scanning of the particular verse that was read by him. The key was connected with a marker, which was so arranged that the deflections were traced upon a recording drum. The distances between the checks in the record line were regarded as representative of the duration of time between the successive points of emphasis.

In the second method a recording lever was attached to the lower lip or to the teeth of the lower jaw, or, though rarely, to the corresponding parts of the upper jaw. A series of monosyllables, consisting of such words as *ba*, *bam*, *pap*, etc., was given to the subject to scan with the utmost regularity in accordance with predetermined types of meter.

The general conclusions indicated that the intervals between the accented syllables of poetry are exactly equal irrespective of the quality of the material which constitutes the intervals. Whenever the number of unemphatic syllables which occur between two accented syllables exceeds the average, they are uttered with a rapidity sufficient to make the intervals equal as to time; and whenever, on the other hand, the number is deficient, the loss is made up either by prolonging the syllables or by introducing pauses.

BRÜCKE's investigation was concerned with a purely mechanical or artificial method of scanning, different from the natural, free, or artistic reading. It is hardly justifiable to apply his conclusions to ordinary spoken verse in support of the principle of equality of feet.² The free rhythmical flow is the expression of impulses, unconsciously operative, that are in the mind of the poet in writing verse.³ Mechanical scansion is the

¹ BRÜCKE, Physiologische Grundlagen der neu-hochdeutschen Verskunst, Wien 1871.

² PAUL, Grundzüge d. germanischen Philologie, II (1) 909, Strasburg 1893.

³ POE, The Rationale of Verse, Works VI 84, 92, Chicago 1895.

expression of impulses consciously striving to produce perfect uniformity, for the sake of a certain pleasure which is derived from the satisfaction of expectant attention. In so far as it is perfectly mechanical, it disregards the logic and sense of the word, for the fuller gratification of these impulses which are relatively incapable of being intellectualized and which subserve but a limited function.

BRÜCKE's conclusions are accurate only within wide limits owing to the inaccuracy of the apparatus of that date. The measurements were recorded on a crude form of the kymograph, the rate of rotation of which could not be increased sufficiently to register¹ the minute differences which inevitably existed between the individual measurements.

In reference to BRÜCKE's second method, we have to consider that the concatenation of syllables in the particular series that was scanned, was arbitrary and artificial. The syllables were uniformly monosyllabic, and of such a character as to require relatively equal strain on the organs of speech in uttering them. A combination of difficult and easy syllables, physiologically considered, would probably have yielded different results.

The experiments of HURST and MCKAY,² with more accurate apparatus, were measurements of the intervals between the beats of the finger made in unison with scanned verse. The method was, in the main, like that of BRÜCKE.

The following conclusions were reached: (1) the feet of a given verse are equal in length; (2) dactyls and trochees are shorter, respectively, than anapaests and iambics; (3) a radical difference exists between the anapaest and the dactyl, the length of the syllables in the former being of an "ascending," in the latter of a "descending," order; (4) there is a lack of a fixed proportion between syllables—the emphatic, however, being longer than the unemphatic.

The postulates which underlie all similar attempts at measuring the duration and equality of poetical feet, are essentially two: (1) the rhythm of the scanned verse agrees with the rhythm of the taps of the finger, and (2) neither exercises an influence upon the other and the rhythm of the finger does not tend to regulate the rhythm of the scansion. Neither of these assumptions is legitimate. In the first place, the two types of motor innervation do not exactly correspond. This has been proved by the experiments of MIYAKE, at the Yale laboratory, in which the subject beat upon an electrical key with the finger as the sounds *ma*, *pa*,

¹ MEUMANN, *Untersuchungen zur Psychologie und Ästhetik des Rhythmus*, Philos. Stud., 1894 X 418.

² HURST AND MCKAY, *Experiments on time relations of poetical meters*, Univ. Toronto Stud. (Psychol. Series), 1900 157.

etc., were spoken into a voice key. The beats of the finger preceded the sounds. A similar result has been obtained in the present series of experiments. The subject was required to beat time on the table upon which the phonograph rested in time with the rhythm of the accents of several verses of faultless meter, which were mechanically scanned. The finger beats were transmitted to the phonograph cylinder through the frame of the phonograph. The results showed discrepancies between the two beats, the beat of the finger generally being anterior to the metrical accents. In the second place, the experiments, to which reference was last made, indicate that the movements of the finger serve as regulators of the movements of the larynx. The subject was directed to scan as regularly as possible both with and without the beats of the finger. The result, as may be seen by turning to the E. H. T. records (Tables LXII. and LXXV. below), was that the regularity in the former instance was more than trebled. This explains the high degree of regularity obtained in the measurements of the two preceding series of researches.

KRÁL and MAREŠ¹ made use of a more direct method of measuring vocal sounds. The apparatus employed was a telephone receiver, in electrical contact with the nerve of a muscle of a frog's leg, the contractions of which were registered upon the smoked paper of a kymograph by means of a recording arm. The sounds spoken into the receiver produced electrical vibrations that stimulated the nerve and caused the muscle to contract.

The experiments included two kinds of measurements: (1) the length of syllables, long and short, uttered separately; and (2) the measures of scanned verse. The language spoken was Bohemian.

Four general results were obtained in this investigation: (1) long vowels and diphthongs, though generally longer than short vowels, were often of the same length; (2) neither of these had absolute time-values, even for the same person; (3) consonants required a very short time for their utterance, the addition of consonants to syllables not being attended by a proportionate increase in the duration of the syllables, and some additions of consonants tending to shorten rather than lengthen the syllables; (4) even in attempting to scan verse so as to exactly coördinate the time of the measures, an equality of time-values was not obtainable, whether the scansion was according to the time theory or the emphasis theory of meter.

While syllables should be measured, not as independent entities but as interrelated elements of a complex group of syllables—the conditions

¹ KRÁL A MAREŠ, *Trvání hlásek a slabik dle objektivné míry*, Listy Filologické, 1893 XX 257.

under which they occur in speech—these conclusions are important as affecting the comparison of like syllables under like conditions. The conclusion with reference to the time-value of poetical measures, it is interesting to notice, is at variance with the conclusions of the two former experimenters.

MEYER,¹ in a series of experiments the publication of which appears never to have been completed, has measured the syllables and feet of spoken verse. An electric tuning fork vibrating 100 times in a second recorded the time line on a smoked drum. A MAREY tambour registered the breath pressure from the mouth. Two trumpet-shaped speaking tubes of paper were attached to the tambour by means of a short glass or metal tube. One of the speaking tubes was made to conveniently fit the mouth cavity; the other, the nose. The tubes could be used singly or in combination. The result of speaking into the tube was to transmit to the rubber diaphragm of the tambour a series of waves corresponding to the sounds and silences of the utterances. The fluctuation of the diaphragm were registered by an amplifying straw lever. Thus the duration of the successive explosions of the stream of outflowing air could be measured. The successive puffs of air were hypothetically assumed to extend over the same times as the successive sounds.

A further development of the apparatus consisted in connecting a tapping instrument to a recording lever whose point was adjusted immediately under the point of the tambour.

The method of taking the records consisted in repeating monosyllables singly or as a series of words, at the same time beating with the finger upon the tapping instrument in time with the articulation of the syllable at the moment of greatest emphasis ("Arsengipfel"). The subject was thoroughly trained in coordinating the time of tapping with the time of uttering the words. The attempt was made to make that point of the syllable which represented the climax of the energy exerted by the vocal organs exactly correspond with the tapping time. This was assumed to be possible, for since both processes start from the same center the maximum points of force of the two innervations should occur synchronously. Thus the tapping mark upon the drum, regardless of where it occurred in the course of the sound, represented the point at which the energy of the syllable was the highest.

The object of the investigation was twofold: (1) to determine the point of highest energy of single syllables beginning with different consonants, such as *pha*, *fha*, *ha*, *za*, *fma*, etc.; (2) to investigate the meter of German verse.

¹ MEYER, *Beiträge zur deutschen Metrik, Neuere Sprachen*, 1898 VI 1-37; 122-140.

The author makes the following general deductions: (1) the point of energy occurs in the initial consonant or consonants somewhere shortly before the beginning of the vowel, varying somewhat according to the difficulty of articulating the consonants¹; (2) the moment of the least, and not the moment of the highest, energy of speech determines the boundaries of the foot²; (3) whenever the beginning of the arsis (part of syllable preceding point of highest energy) coincides with the beginning of a syllable, and the end of the thesis (part following the point of highest energy) coincides with the end of the syllable, the boundaries of the foot coincide with the boundaries of the syllables²; and (4) whenever unemphatic syllables uniformly coincide with the arsis or the thesis of an accented syllable, the boundaries of the foot of verse and prose ("Sprechakt") become identical.²

MEYER states³ that the investigation was subject to the following sources of error, which were incapable of elimination: (1) latent time of the apparatus ("Registrirverzögerung"), some loss in the time of transmission, and in the quantity of the energy to be recorded in the passage from the receiving to the recording points being inevitable; (2) errors of measurement ("Wahrnehmungsverzögerung") owing to the limited capacity of the visual organ to discriminate small differences.

The following considerations, as affecting MEYER's experiments, may be noted: (1) The measurements are essentially measurements of breathing. The air waves may or may not precisely coincide with the sounds. (2) An exact simultaneity in the occurrences within the central organs of the highest points of energy for the innervations of the vocal muscles and the muscles of the hand may perhaps be assumed. The additional assumption is made that the registering of the impressions are also synchronous. Since, however, the media for transmitting the impressions are not the same (the air and the hand), this may be unjustified. Moreover, it has been proved that no muscular movements are capable of exact coordination. Contrary to the supposition (although the movements of the hand are not reactions to the movements of the organs of speech) that the movements of the hand and vocal organs are not subordinate but coordinate, the movements of the hand may serve as a regulative concomitant of the movements of the vocal organs. For this reason the results may not apply to the rhythm of free declamation.

¹ MEYER, *Beiträge zur deutschen Metrik*, Neuere Sprachen, 1898 VI 134.

² MEYER, as before, 138.

³ MEYER, as before, 26–30.

TRIPPLETT and SANFORD,¹ using apparatus similar to that of BRÜCKE, HURST and MCKAY and MEYER, have measured eleven nursery rhymes of long, common and short meter, scanned by themselves eight or ten times with great regularity, and have studied without apparatus, the patterns adopted. A finger record of taps, a vocal record representing breath puffs, and a time line, made by an interrupter checking off tenths of a second, were traced on the kymograph. The voice record was used for comparing the exactness of the correspondence between the finger taps and the expiratory stresses. The intervals between the finger taps were measured.

The following conclusions were reached: (1) If the pause intervals between the larger rhythmic units are excluded, the measures of scanned nursery rhymes are approximately uniform. (2) There is a tendency to accelerate the speed of scanning the successive measures in the verse as well as the successive verses themselves. (3) No characteristic differences of speed are found between dactylic and trochaic, anapestic and iambic measures. This is contrary to the results of previous experimenters. (4) The most frequent patterns of verse have a characteristic movement, due partly to the distribution of the pauses and the tendency to increase the speed.

This cursory review of previously existing methods of experimentally investigating the time relations in speech illustrates and enforces the necessity of improved methods of speech investigation. Two types of methods may be used. The former is largely the method which has prevailed up to the present time. The sounds of spoken language have been measured by means of finger beats, currents of air and non-reproducible sound vibrations. A more direct method consists in measuring directly the sounds recorded in, and reproduced by a talking machine. This method has the following advantages:

1. The instantaneous action of the recording stylus of the modern talking machines practically eliminates the errors of the "latent time" of the apparatus and the recording of superfluous and irrelevant movements.
2. It is the only method by which the accuracy of the recorded impressions can be completely verified, since it alone affords the means of reproducing the sounds that have been recorded. The accuracy of the impressions recorded upon instruments of the non-reproducing kind, must always remain more or less conjectural.

¹ TRIPPLETT AND SANFORD, *Studies of rhythm and meter*, Am. Jour. Psych., 1901 XII 361.

II. APPARATUS.

The experiments now to be described were begun in the early summer of 1900 and carried out during the academic year 1900-1901.

The machine used in making records was a LIORET phonograph, resembling the graphophone in its construction. The rate of speed was accurately recorded.

For reproducing purposes an EDISON phonograph was used. A gear wheel with twenty-four teeth having the spaces filled with vulcanized rubber was placed on the axle of the phonograph. A metal spring resting upon the wheel made contact with each tooth. Every revolution of the contact wheel made twenty-four closures of the circuit. An EWALD magnetic counter placed in the circuit indicated the number of teeth passing under the end of the spring.

A telegraph key was placed on each side of the phonograph. By pressing the knob of the key on the left side, the current was sent through the counter; by pressing the key on the right side the circuit was interrupted. In this way the number of contacts between the movements of the two keys was obtained. A knowledge of the rate of revolution of the phonograph cylinder when the record was taken made it possible to translate the number of contacts into seconds.

The limit of the greatest possible speed capable of being utilized was determined by two factors: (1) the degree of dexterity developed by the experimenter in reacting upon the telegraph key to the given impressions; and (2) the limit of accuracy of the magnetic counter. Beyond a certain rate of speed the counter failed to register all the contacts. In none of my measurements was this limit even approached. The highest number of contacts per minute required in the measurements was 2,880. The instrument was capable of registering a much higher number of contacts. Within the limits of speed, however, the accuracy of the measurements depended upon the maintenance of a fairly constant relation between the strength of the electrical current and the tension of the spring of the armature of the counter magnet. The accuracy of the chronoscope was verified by comparing the gross measurement of a large interval (*e. g.*, a verse or a stanza) with the aggregate of all the smaller intervals composing it (the measures and pauses); and by comparing the time required to measure off a stanza with the time required to record it, which had been ascertained by the watch.¹

The limit of the slowest speed was dependent upon discriminative audibility. At a certain speed the sounds lose their articulate character.

Except for very special reasons, the speed used in measuring corresponded to the speed used in taking the records. This varied from 80 to 120 revolutions per minute. By maintaining the recording speed the records were heard, in respect to speed and pitch, as they were made. The measurements which were made before the experimenter developed a high degree of proficiency were rejected.

The method of measuring consisted in first listening, through the ear tubes, to the record upon the cylinder and choosing the intervals to be measured. The intervals were then listened to repeatedly, and each one was measured from four to five times by pressing one key at the beginning and the other at the end. The average of the different measurements was recorded as the length of the interval. The successive measurements of the same interval differed only very slightly, and were frequently identical; the measurements were thus quite accurate.

In making the phonograph records upon which this research is based, the procedure was guided by the following considerations:

1. All mechanical distractions and impediments, such as noises, strain of the muscles of the body or head occasioned by a forced standing or sitting posture, interference with the easy movements of the lips, fatigue, etc., of the subjects, were eliminated as far as possible.
2. The material contributed for study should come from subjects without bias or preconception.
3. The subjects were uninstructed in respect to the purposes of the experiment, except where the nature of the experiment required otherwise, in order to minimize the elements of unnaturalness and intentional change of the manner of speaking.
4. The subjects were of varied characters, with different languages, from different countries, of different stages and walks of life (elementary and high school pupils, academic and graduate students, professors, poets, orators, musicians, etc.).
5. The character of each record was made a true copy of the natural characteristics of the mode of delivery of the subject, so as to be typically his own, no matter what the idiosyncrasies.

By requiring the utterance to be natural the research could assume the rôle of being an investigation into the rhythmic peculiarities of actual speech. In a few cases, however, it seemed advisable to omit offering any instructions and the matter was left entirely to the taste of the reciter. Moreover, in proffering suggestions due care was taken lest the advice should tend to make the subject too self-conscious. Cases of mechanical scansion were also included for the sake of comparison and completeness of scope.

III. THE CENTROID.

1. *Concept of the centroid.*—A portion of speech such as “the cities are full of pride,” is physically a vibratory movement of a complicated form of which various portions can be assigned in succession to the sounds δ , α , s , i , t , i , z , etc., with more or less abrupt changes (glides) between them. The series of sounds represents : (1) a continuous succession of vocal movements representing work, (2) a continuous vibration of an air particle, (3) a continuous succession of sensations. Both the speaker and the hearer feel the recurrence of points in the succession at which the impression reaches a maximum. These maxima are felt to have their positions determined not only by the actual maxima of vocal effort and of acoustic impression but also by the preceding sounds and by the anticipation of following ones. Owing to these circumstances the maxima as felt may differ more or less from the actual vocal or acoustic maxima. Such a maximum of effect may be called a ‘centroid.’”

The English poetical line may be considered as a certain quantity of speech-sound distributed so as to produce an effect equivalent to that of a certain number of points of emphasis at definite intervals. The location of a point of emphasis is determined by the strength of the sounds at and around it. It is like the centroid of a system of forces or the center of gravity of a body in being the point at which we can consider all the forces to be concentrated and yet have the same effect. The centroid is not a syllable or a single sound but a point in the course of a sound.¹

In the stream of vocal sounds the centroid lies in the syllable that relative to adjacent syllables, contains the maximum amount of force or loudness. The syllable containing the centroid may be called the “centroid syllable.” It has been called the accented, emphatic, stressed, long or loud syllable.

Every syllable in a verse or sentence may contain a centroid. Whether it is actually to become a centroid syllable when the words are read, will depend upon its logical function and the circumstances of the utterance.

When the component sounds of speech are considered separately, the centroid represents the maximum of energy of a syllable. This point may, theoretically, either fall midway in the syllable, or precede or follow the middle point. According to BRÜCKE,² basing his deduction upon the

¹ SCRIPTURE, *Researches in experimental phonetics (first series)*, Stud. Yale Psych. Lab., 1899 VII 101.

SCRIPTURE, *Elements of Experimental Phonetics*; New York 1901.

² BRÜCKE, *Physiologische Grundlagen der neu-hochdeutschen Verskunst*, Wien 1871.

measurement of scanned verse, when the vowel of the emphatic syllable is short, the maximum of energy occurs at the end of the vowel or just before the following consonant ; when the vowel is long and not immediately followed by a consonant, it lies somewhere in the course of the vowel ; and when the vowel is long, but does not terminate the syllable, the point lies very near the boundary between the vowel and the consonant. According to MEYER¹ the point of highest energy in syllables consisting of a vowel with an initial consonant lies in the early part of the syllable, shortly before the beginning of the vowel sound.

The physical factors that locate the centroid are increase of amplitude, increase of length and change in pitch.

Typical cases would be $c = a_{0.7} + l_{0.2} + p_{0.1}$, or $c = a_{0.4} + l_{0.2} + p_{0.4}$, or $c = a_{0.3} + l_{0.4} + p_{0.3}$, etc., where c indicates the strength of a given centroid, a , l and p the factors of amplitude, length and period, and the subscripts the share contributed by each.

2. *Kinds of centroids.*—Centroids admit of distinctions of kind only from the psychological point of view. We may use the term "phrase centroid" to denote the major or chief centroid of a given phrase. Each phrase should contain one chief centroid, one dominant idea, one specially important word.

According to the purposes of thought and feeling subserved by the centroid, we obtain a threefold division : rhythmic, pronunciatory and logical.² The function of the first is to mark off the different measures of verse ; of the second, to emphasize the root syllables of words ; of the third, to single out prominent words for special emphasis.

SUNDÉN³ distinguishes two kinds of accent in Swedish : (1) Word accent, or the stress belonging to a separate word, constituting the word when of two or more syllables a sound unity. This is subdivided into (*a*) compound, or such accent as belongs to polysyllabic words having a *grave* accent ("gravis" = accent with low tone) on one syllable and a *strong* subsidiary accent ("levis") on the other, *e. g.*, in *Anna*, *konung* and *månsken* ; and (*b*) simple, or the stress belonging to a monosyllabic word with *acute* accent ("akut" = accent with high tone), and a polysyllabic word with a *weak* subsidiary accent, *e. g.*, in *bok*, *böcker* and *böckerna* (*akut* on first syllable). (2) Phrase or rhetorical ("oratorisk") accent, or the stress of a word in its relation to other words.

Physically there are no distinctions of kind among centroids. There are no physical signs in the vibrations upon the phonograph cylinder

¹ MEYER, *Beiträge zur deutschen Metrik*, Neuere Sprachen, 1898 VI 123.

² LANIER, *The Science of English Verse*, Chap. IV., New York 1880.

³ SUNDÉN, *Svensk Språklära*, 15, Stockholm 1895.

whereby the logical varieties can be distinguished. The physical process is a continuity, admitting of distinctions of degree, the general characteristics of which are shared by all centroids.

That we are justified in considering all kinds of emphatic syllables as centroid syllables, also appears from a consideration of the centroid as a process in consciousness. The centroid is an impression which arouses the sense of hearing to a certain pitch of intensity for a certain length of time. It is in respect of intensity that consciousness distinguishes it from other auditory sensations of the same nature. The strong sensations, irrespective of logical distinctions, are designated centroid syllables, the faint sensations, non-centroid ones.

Hence, as an objective physical occurrence, measureable in amplitude, period and length, and as an event in consciousness, capable of being roughly estimated in respect to intensity, any emphatic syllable may be included in the generic term of centroid syllable.

The psychological differences in the centroid may be accompanied by correlative differences in tone-color or timbre of voice.

3. *Method of locating the centroid.*—Two methods are available: (1) We may measure the tracings of sound curves of the talking machines. The centroid will be located at that point along the time-axis of a syllable where the influences of amplitude, length and pitch are the greatest. (2) By listening to a phonograph record, and comparing the consecutive syllables in respect to the intensity of the auditory sensation which they arouse, we may classify the syllables as weak and strong. This purely psychological method lies closest to nature, because speech centroids, fundamentally considered, are mental quantities.

The psychological method, according to which the centroids have been located in the present experiment, has been attended with some difficulty. It has sometimes, though rarely, been difficult to determine which of two, or whether any one of two, consecutive syllables is a centroid. Appeal has frequently been made to other persons. Where doubtful cases exist, the fact is indicated in the records by placing a ? directly after the centroid.

4. *The elements of the centroid.*—The centroid in speech is the result of a number of complex mental forces which constitute an original and inseparable synthesis, and which are the indispensable conditions of the life of the centroid. These elements, constituting the fundamental framework of the centroid, are capable of isolation by processes of analysis only; in any concrete case they constitute an irreducible complexity.

This complexity of elements is threefold—including the factor of time, factor of force, and factor of pitch. Every sound that is uttered is con-

ditioned on these three fundamental processes. Every sound is concrete—of a particular pitch, intensity and duration.

Furthermore, in order to excite the organ of hearing and give rise to a percept, every sound must attain a certain intensity, persist for a certain time, and fall within the limits of the psychological scale of pitch. Hence, both physically and psychologically considered, these three elements form the ultimate elements of the centroid.

5. *The essence of the centroid.*—The question now arises, which, or how many, of these factors constitute the essence of a centroid?

(a) Historical summary.—Several answers, somewhat obscure and inconsistent, have been given to the above questions. To enter into a detailed discussion of these would be out of place. The distinctions that have been introduced have turned either upon differences as existing between different languages or as existing within a given language.

According to SWEET¹ and POE² accent is practically non-existent in French poetry.

Accent in the case of ancient Latin³ and Greek,⁴ as well as in ancient and modern Sanskrit⁵ and Persian, has been described in terms of pitch. The nearest modern approaches to this species of emphasis are the Swedish and Norwegian languages (*akut accent*), the verse of which, however, is governed by different laws. The Scotch emphatic syllable, on the other hand, has been characterized as having a “grave tone,”⁶—that is to say, as lacking almost entirely in pitch modification. Theoretically Scotch would afford an instance of a monotone speech. SUNDÉN⁷ states that grave accent (*gravis*) is peculiar to Swedish and Norwegian; and elsewhere,⁸ that in Swedish the elements of pitch (melodic accent, “*tonhöjd*”) and loudness (expiratory or dynamic accent, *tonvikt*“) coincide, and that an accented⁹ syllable (*akut* or *gravis*) is always long.

The property of duration is said to contain the essence of the centroid in Latin, Greek, Arabic, Persian and Sanskrit, by MAYOR¹⁰ and ELLIS.¹¹

¹ SWEET, Primer of Phonetics, 45–97, Oxford 1890.

² POE, The Rationale of Verse, Works, VI 100, Chicago 1895.

³ ELLIS, The Quantitative Pronunciation of Latin, 21, London 1874.

⁴ SYMONDS, Sketches and Studies in Southern Europe, II 328, New York 1880.

CLARK, Manual of Linguistics, 155

⁵ CLARK, Manual of Linguistics, 155.

⁶ GUEST, History of English Rhythms, II, London 1882.

⁷ SUNDÉN, Svensk Språklära, 15, Stockholm 1895.

⁸ As above, 14, 17.

⁹ SUNDÉN, Kort Översigt af Svenska Vitterhetens Historia, 20, Stockholm 1885.

¹⁰ MAYOR, Chapters on English Metre, London 1886.

¹¹ ELLIS, The Quantitative Pronunciation of Latin, 21, London 1874.

In the following two groups, emphasis is resolved into terms of loudness or expiratory stress: Modern Greek, Italian, Spanish, German and English;¹ and old Italic, Keltic, Teutonic and Lithuanian.²

Just how far these distinctions are valid, it is not our purpose to discuss. This remains as a problem for future investigation.

We have reserved the theories of English accent for separate consideration. It is in this province that our chief concern lies.

It is difficult to classify, or bring into any sort of unity, the different utterances on the nature of the centroid in English verse, so indefinite and conflicting are the statements—statements that have been characterized as more pitiable nonsense than has ever been written on any other subject under the sun.³ If we divorce the problem now under consideration from the connected problem of the quantitative character of English verse, which is reserved for discussion in the following section, the difficulty is increased. We are here concerned with the properties only of the centroid as such, and not of the centroid as a member of a succession of centroids.

The most prominent feature in the discussions of English prosody is the widespread assumption that the centroid in English is essentially a phenomenon of loudness, force, or stress. This position is maintained by ABBOTT and SEELEY,⁴ MAYOR,⁵ WALLIS,⁶ GUEST,⁶ GURNEY,⁷ ELLIS,⁸ LANIER⁹ and others. A somewhat modified view is to the effect that there is a natural, although not an essential, connection between increase of force and increase of duration.¹⁰ According to this view quantity is secondary; it is the variable element, while loudness is the stable element. ARNOLD¹¹ goes perhaps a step further in affirming that in English poetry, “ accented syllables are long, and unaccented short.” POE¹² holds that our starting point in the conception of verse is quantity or length; we begin with the long syllable, and the long syllable is the encumbered or emphatic one. JOHNSON,¹³ the litterateur, transferred the conditions of classical accent to

¹ MAYOR, Chapters on English Metre, London 1886.

² CLARK, Manual of Linguistics, 155.

³ POE, The Rationale of Verse, Works, VI 59, Chicago 1895.

⁴ ABBOTT AND SEELEY, English Lessons for English People, 153-154, Boston 1880.

⁵ MAYOR, Chapters on English Metre, III, London 1886.

⁶ GUEST, A History of English Rhythms, IV, London 1882.

⁷ GURNEY, The Power of Sound, 429, 433, 437, London 1880.

⁸ ELLIS, The Quantitative Pronunciation of Latin, II, London 1874.

⁹ LANIER, The Science of English Verse, I and II, New York 1880.

¹⁰ SEELEY AND ABOT, GUEST, MAYOR, ELLIS, SYMONDS.

¹¹ ARNOLD, Manual of English Literature.

¹² POE, The Rationale of Verse, Works, VI 59, 79, 88, Chicago 1895.

¹³ GUEST, as above; CORSON, A Primer of English Verse, IV, Boston 1893.

English verse : the emphatic syllable is invariably long. LOTZE¹ ventures the suggestion, without limiting its applicability to any one language, that the emphatic syllable always requires a longer "Sprechzeit."

MITFORD,² a musician, held that "sharpness" or pitch constituted the essence of the accented syllable ; and SCHMIDT,³ that there is an almost inseparable connection between pitch and intensity in English. Finally, SWEET⁴ asserts a natural, though not a necessary connection between all the three elements.

(b) Experimental solution. (1) Method.—The method employed in determining the essence of the centroid was as follows : Selecting the centroids which had been previously located, of any given record, the stylus of the recorder was made to pass over each syllable a score or so of times, with varying rates of rotation of the cylinder. By thus listening attentively to the same syllable under varying conditions, it was possible to determine what element, or elements, were predominant in the sense-impression.

The results were indicated by placing appropriate symbols above the syllables. The next step consisted in verifying, by all available means, the results of mental discrimination. In respect to duration, the method employed was to measure the length of the syllables marked duration centroids ; in respect of pitch, the syllables marked pitch centroids were compared with the pitch of adjacent syllables by aid of the piano. The element of duration and pitch could thus be estimated with great precision as regards their physical aspects. Viewed psychologically, however, that is to say, from the point of view of their importance as elements of intensive states of consciousness, a value could be assigned to each only when compared with other points of emphasis, by way of contrast, similarity, etc. Finally, the estimate of loudness reposes upon the immediate testimony of consciousness. These considerations, however, do not effect the certitude of the determinations with reference to the mere differentiation of the different factors. It is only as respects the degree of loudness that the judgments may be questioned.

Altogether 513 centroids, selected from eight different records were studied, namely, those of W. L. P., J. W. R., G. A. A., C. O. S., A. D. B., C. O., W. C. and W. W. The results are given in the two following tables.

¹ LOTZE, *Geschichte des Aesthetik*, 301.

² GUEST IV, and CORSON IV, as before.

³ SCHMIDT, *Introduction to the Rhythmic and Metric of the Classical Languages*, 17, Boston 1878.

⁴ SWEET, *Primer of Phonetics*, 67, Oxford 1890.

TABLE I.

Centroid elements.

Principle of synthesis.

\circ_1	\circ_2	\circ_3	\triangle_1	\triangle_2	\triangle_3	\bullet_1	\bullet_2	\bullet_3	\circ_1	\circ_2	\circ_3	\triangle_1	\triangle_2	\triangle_3	\bullet_1	\bullet_2	\bullet_3	\triangle_1	\triangle_2	\triangle_3
<i>n</i>	250	35	3	5	16	20	9	7	14	1	3	6	2	1	4	2	7	4	1	
<i>t</i>	288		41			16			15		II							5		

n, number of centroids.*t*, aggregate number of centroids per group.

1, 2, 3, degrees of centroids.

Number of centroids in entire series of groups, 383.

TABLE II.

Centroid elements.

Principle of substitution.

\circ_1	\circ_2	\circ_3	\bullet_1	\bullet_2	\circ_3	\triangle_1	\triangle_2	\triangle_3
<i>n</i>	15	30	14	28	20	7	II	5
<i>t</i>			59			55		16

n = number of centroids.*t* = aggregate number of centroids per group.

1, 2, 3, degrees of centroids.

Number of centroids in entire series of groups, 130.

(2) Explanation of symbols.—The following symbols are designed to represent the properties, or property, which enter into the make up of the centroid.

The open circle (\circ) denotes a relative equality of pitch, loudness and duration emphasis. Ideally this sign should signify that the share contributed by anyone of these elements is equal to that of any one of the others. The equality, however, is only relative. In English and perchance in other modern languages, the element which has the greatest claim to supremacy is that of loudness. Hence the open circle is representative of a synthesis of three elements, in which the element of loudness is slightly predominant.

In the dot circle (\bullet), or the circle with the dot in the center, the factor of loudness distinctly predominates over the factors of duration and pitch; in the closed circle (\circ) the element of duration preponderates; and in the inverted triangle the pitch factor overbalances the other two. Of the latter sort two alternatives are possible. The pitch emphasis may be due, in both cases by way of contrast, to a raising (\triangle) or lowering (∇) of the pitch. The latter is the rarer of the two, as will be seen by a study of the records. Theoretically, either is an extreme departure from the medium pitch of any given record, and tends to an increase of emphasis.

The superposition of one symbol upon another signifies that the symbol which is placed underneath contributes the main part of the total effect. The upper sign indicates the element next in importance. The third element, of course, is subordinate to the element of the uppermost sign.

In each of these cases one element is predominant; while the other two are subordinate to this element, they may be equal to each other. The weaker elements are always present as the substratum of the centroid. They are the conditions of its very possibility as a vocal phenomenon. The abolition of any one signifies the abolition of the process of vocalization.

The effect of these several amalgamations, as well as the relations which they sustain to one another in respect to frequency and stress, will be seen in what follows.

6. *Degrees of the centroid.*—The subscripts to the symbols denote the relative degrees of the force or strength of the centroid as an effect in consciousness. They indicate the degree of the *entire centroid* and not that of the particular elements to which they are attached. A great number of variations in stress are possible, but the degrees have been limited to the first, second and third. Consciousness can immediately distinguish three degrees of auditory sensations: (1) high, medium, low; (2) loud, medium, weak; (3) long, medium, short.

ELLIS,¹ has elaborated a scheme, whose main defect is its over-minuteness of analysis, in which five different elements (force, length, pitch, weight, and silence) of emphasis are distinguished. To each one of these elements he ascribes nine possible degrees of stress. The theory has been justly criticised, as well as misinterpreted.² The misinterpretation is due to a misunderstanding of the nature of the centroid. The centroid, as already affirmed, is not the resultant of the agglomeration of isolated fragments superimposed upon one another, but a complexity originally and inseparably multiplex. None of its elements exists in isolation. Nothing is added to a third degree centroid, except an intensification of one or all of its elements. Hence the scheme of ELLIS provides for nine degrees of stress, and not for forty-five,³ as has been supposed.

A like over-minuteness of analysis is characteristic of the system of SWEET.⁴ He distinguishes five degrees of quantity (very long, long, half long or medium, short, very short), three degrees of force (level, crescendo, diminuendo), four degrees of stress (very strong,

¹ ELLIS *Accent and emphasis*, Trans. Eng. Philol. Soc., 1873-74 and June, 1876.

² MAYOR, Chapters on English Metre, 57-74, London 1886.

³ MAYOR, Chapters on English Metre, 69, London 1886.

⁴ SWEET, Primer of Phonetics, 43-66, Oxford 1890.

strong, half strong, weak), and three primary forms of intonation (level, rising, falling).

In Swedish¹ the following degrees are recognized: 4th, the principal accent of the *acute* species, e. g., the first syllable of *anden* (from *and*); 3d, the principal accent of the *grave* species, e. g., the first syllable of *anden* (from *ande*); 2d, the strong subsidiary accent, e. g., the second syllable of *anden* (from *ande*); 1st, the weak subsidiary accent, e. g., the first and third syllable of *universitet*; and o, the weakest accent ("tonlöshet"), e. g., the second and fourth syllables of *universitet*. No word has more than one principal accent (4th or 3d), nor more than one strong subsidiary (2d).

The groups in Tables I. and II. are arranged according to the order of frequency of occurrence. We shall consider them separately under the principles which they exemplify.

Principle of synthesis.—The several groups of Table I., which result from the different modes of combination of the elements, may be studied from two points of view: frequency of occurrence and degree of intensity.

The most frequent combination is o, where loudness is slightly more prominent than duration and pitch. This constitutes 75.1% of all the groups. The next, the loudness-pitch fusion ($\triangle\circ$), where loudness is distinctly predominant, represents 10.7%; the loudness-duration ($\circ\bullet$), 4.1%; the duration-loudness ($\circ\circ$), 3.9%; the pitch-loudness ($\circ\triangle$), 2.8%; the duration-pitch ($\bullet\triangle$), 1.8%; and the pitch-duration ($\bullet\circ$), 1.3%. The two extremes consist of the o and the \triangle (pitch-duration). Perhaps it may be justifiable to regard the former as the normal, or most natural, and the latter as the abnormal, or most unnatural, mode of fusion. A fact scarcely less striking is that the loudness-pitch ($\triangle\circ$) combination is almost equal in frequency to all the others, exclusive of the o centroid. In respect to frequency, therefore, the element of loudness stands pre-eminent. It is present as a distinctly apprehended element in all except two groups of combinations.

The following percentages, as to the degree of intensity arising from these fusions, obtain between the different degrees of each mode of synthesis:

$$\circ \left\{ \begin{array}{l} 1^\circ = 86.8\% \\ 2^\circ = 12.1 \\ 3^\circ = 1 \end{array} \right. \quad \triangle \left\{ \begin{array}{l} 1^\circ = 12.2\% \\ 2^\circ = 39. \\ 3^\circ = 48.7 \end{array} \right. \quad \bullet \left\{ \begin{array}{l} 1^\circ = 00 \% \\ 2^\circ = 56.3 \\ 3^\circ = 43.7 \end{array} \right. \quad \circ \left\{ \begin{array}{l} 1^\circ = 00 \% \\ 2^\circ = 93.3 \\ 3^\circ = 6.6 \end{array} \right.$$

$$\triangle \left\{ \begin{array}{l} 1^\circ = 27.2\% \\ 2^\circ = 54.5 \\ 3^\circ = 18.2 \end{array} \right. \quad \bullet \left\{ \begin{array}{l} 1^\circ = 14.3\% \\ 2^\circ = 57 \\ 3^\circ = 28.5 \end{array} \right. \quad \triangle \left\{ \begin{array}{l} 1^\circ = 00 \% \\ 2^\circ = 80 \\ 3^\circ = 20 \end{array} \right.$$

¹ SUNDÉN, Svensk Språklära, 14, Stockholm 1895.

1. Of all the fusions the \circ (normal) centroid alone has the highest percentage in the first degree and the lowest in the third degree. All the others have the smallest percentage in the first degree, with the exception of Δ (pitch-intensity).

Psychologically, this signifies that the normal or most prevalent mode of synthesis, though excelling in frequency, is vastly inferior in intensity. When an increase in intensity is effected, some one factor gains prominence.

2. The loudness-pitch (Δ) synthesis alone has the highest percentage in the third degree. Hence this is the most effective mode of fusion in respect of intensity. The loudness-duration synthesis (\bullet) is a close second.

3. All of the last five modes of synthesis of Table I. (loudness-duration, duration-loudness, pitch-loudness, duration-pitch, pitch-duration) have the highest percentage of centroids in the second degree. As second degree centroids, the duration-loudness and pitch-duration stand preëminent.

Thus far the elements have been considered in conjunction. No one element has been supreme. We now proceed to study the cases in which some one element predominates.

Principle of substitution.—The percentages of frequency are as follows (Table II.): loudness, 45.3 per cent.; duration, 42.3 per cent.; and pitch, 12.3 per cent. The proportion, though not as large as for the previous class, is seen to follow the same general order; the extremes are composed of the loudness and pitch centroids. In so far as these may be regarded as independent sources of intensity, loudness and duration are each employed nearly four times as frequently as pitch. Loudness is slightly more prevalent than duration.

The average length of the duration type was 0.28^s, which exceeds the average length of the normal centroid by 0.09^s. That is, it is 1.47 times longer than the average length of the ordinary emphatic syllable (falling under the principle of synthesis).

As to degrees of intensity, the following relations are sustained :

$$\circ \left\{ \begin{array}{l} 1^\circ = 25.4\% \\ 2^\circ = 50.8 \\ 3^\circ = 23.7 \end{array} \right.$$

$$\bullet \left\{ \begin{array}{l} 1^\circ = 50.9\% \\ 2^\circ = 36.3 \\ 3^\circ = 12.7 \end{array} \right.$$

$$\Delta \left\{ \begin{array}{l} 1^\circ = 68.7\% \\ 2^\circ = 31.2 \\ 3^\circ = 00.0 \end{array} \right.$$

Observations and conclusions.—A study of the two principles suggests the following conclusions :

1. The element of loudness ranks highest in the degree of intensity attainable through the employment of any one element as a substitutive

instrumentality ; duration is equal to about one-half the effectiveness of loudness, while pitch independently is inferior to duration. In some records these elements very rarely play an approximately independent rôle. This tends to heighten the effect, in harmony with the general principle of contrast, when they are fitly employed.

2. The chief function of duration and pitch as substitutive elements consists in producing a first degree centroid, or in constituting a doubtful syllable, as compared with an adjoining syllable, a centroid syllable.

Speculation may be indulged in as to the special functions, psychologically, of pitch and duration emphasis, considered as vehicles for expressing different states of thought and feeling. It may be suggested that the third degree duration emphasis seems specially adapted to express the emotions of awe and grandeur, as well as solemn and grave thoughts. Notice, for example, the frequent use that is made of the duration type of emphasis in the pulpit and on the rostrum (cf. record of C.O.S., below).

3. The chief function of loudness as a substitutive property, appears to consist in producing a second degree centroid; a like function seems to be subserved by the duration loudness (\circ), the pitch-duration (\bullet), the duration-pitch (Δ) and pitch-loudness (\triangle) centroids. Loudness independently is equal to any one of these integrations in effectiveness of intensity.

4. The thought is suggested that the function of the coalescence of loudness and pitch (Δ), and probably of loudness and duration (\circ), lies in the production of a third degree, or maximum, centroid effect. It is the former mode of synthesis that displays a highest percentage in the third degree.

5. The function of the loudness-pitch-duration (\circ) mode of fusion, in which loudness is slightly the most important element, consists in serving as the substrate of the speech centroid ; and in constituting a syllable a centroid syllable when a constituent of a sequence of words.

Assuming \circ to be the threshold of intensity of the centroid, all syllables that fall below the threshold may be designated non-centroidal or weak syllables. They are lesser or fractional centroid syllables. There is a natural series of gradations below, as well as above, the threshold of the centroid. The threshold is always relative to any given speech record ; it is not a fixed quantity but is always more or less arbitrary.

6. A comparison of the two principles shows that the principle of synthesis, in respect to frequency of employment, sustains a relation to the principle of substitution, approximately as 3 : 1. The integrated centroids are employed about three times as frequently as the substitutive centroids.

7. In respect to the third degree of intensity, the proportion between the effectiveness of the mode of synthesis centroids and the mode of substitution centroids is as 1.54 : 1. For the second degree, the proportion is as 1.41 : 1; and for the first degree, as 1 : 2.47. In other words, the second and third degree integrated centroids are each about 50 per cent. more frequent than the second and third degree substitutive centroids. The first degree substitutive centroids, on the other hand, are about two and a half times more frequent than the integrated centroids. The centroids consisting of integrated elements are thus seen to be far superior to the centroids consisting of substitutive elements, as regards intensity.

8. To adequately account¹ for all the variety of force relations obtaining among centroids, two principles have to be invoked: the principle of substitution and the principle of synthesis. Both are important, but the last is the more effectively employed, both with reference to frequency and strength. The employment of both principles conduces to pleasing variety, richness and melody, and physical and mental economy in speech. A due observance of the two principles contributes no inconsiderable part to the enjoyment derived from listening to a good reading.

9. Although the essence of the centroid is always a threefold complexity, any one of the elements may become predominant, though not entirely supreme.

7. *Relation of the centroid to the parts of speech.*—A question which is immediately suggested by the foregoing considerations is the relation, both in respect of prevalence and degree of intensity, which the parts of speech sustain to the centroid. To determine this, 336 centroids were classified according to the kinds of words of which they were composed. The results are tabulated in Tables III. and IV.

TABLE III.
Distribution of the centroid among parts of speech.

<i>Kind.</i>	<i>n</i>	<i>%</i>
Nouns,	107	0.31
Verbs,	77	.22
Adjectives,	59	.17
Adverbs,	40	.11
Conjunctions,	21	.06
Prepositions,	16	.04
Personal pronouns,	11	.03
Proper nouns,	4	.01
Interjections,	1	.003

n, number of occurrences.

%, percentage of all occurrences.

¹ The element of quality, or timbre, has been left out of the account.

TABLE IV.

Relation of degrees of centroids to parts of speech.

<i>Kind.</i>	I°	II°	III°
Nouns,	0.54	0.37	0.09
Verbs,	.54	.35	.10
Adjectives,	.35	.44	.20
Adverbs,	.77	.15	.07
Conjunctions,	.95	.00	.04
Prepositions,	1.00	.00	.00
Personal pronouns,	.54	.27	.18
Proper nouns,	.50	.00	.50
Interjections,	.00	.00	1.00

8. *Observations and conclusions.*—While the determinations are largely tentative, they point to a few facts which may be accepted as trustworthy.

1. The nouns and verbs rank highest, respectively, in grade of frequency. The adjectives come third, with a little over one-half the frequency of the nouns, and a trifle over three-fourths the frequency of the verbs. The interjections and the proper nouns rank the lowest.

2. Excluding the interjections, only one case of which was studied, all the different kinds of words have their highest percentage in the first degree, except the adjectives and the proper nouns. The latter are evenly distributed among the first and third degree centroids. The former have the largest percentage in the second degree, and also rank next to the highest of any part of speech in the third degree column. As between nouns and verbs, a parallel proportion obtains. Over half the number are first degree, a little over one-third are second degree, and only one-tenth are third degree centroids. The personal pronouns follow the same general course except that the percentage in the third degree is relatively about twice as high. In the adverbs, on the other hand, the gradation is very rapid from the I° to the II°; the percentage of III° is about one-half of II° adverbs. The conjunctions and prepositions are almost wholly limited to the first degree.

In the main, then, it seems that, as regards the intensive or stress aspect of words, the parts of speech rank in the following order: proper nouns, adjectives, personal pronouns, verbs, nouns, adverbs, conjunctions and prepositions. The proper nouns, however, may be considered doubtful, as only four cases were studied.

The subsumption according to degree of stress differs, it will be seen, from the subsumption according to the frequency of occurrence.

It is interesting to compare these results with the rules of accentuation propounded by GUEST,¹ according to which articles are rarely accented;

¹ GUEST, A History of English Rhythms, 85, London 1882.

qualifying words—for example, adjectives, adverbs, and possessive pronouns—receive a fainter accent than the words they qualify; personal and relative pronouns take a fainter accent than the verbs; and in words compounded of a substantive and adjective, the accent falls on the adjective. This theory is somewhat at variance with the above determinations.

SUNDÉN¹ holds that articles in Swedish are never accented. Pronouns, auxiliary verbs, prepositions and conjunctions are generally not accented.

It is quite apparent upon the surface, that, with reference to any part of speech, no rules can be laid down that admit of no exceptions. The same noun, adjective, verb, adverb, pronoun, etc., may at one time be a first, at another a second, and at yet another a third degree centroid, depending upon the relative importance which the word plays as a vehicle for the conveyance of the thought that is uppermost in the mind of the speaker on any given occasion.

9. *Recapitulation.*—The discussion of the preceding pages has been confined to a treatment of the centroid as an isolated element in speech—that is, a definition of the concept, the kinds, the elements, degrees and essence (as illustrated in the principles of integration and substitution), and the word-analysis of the centroid, have been given. The next step consists in studying the centroid as a constituent member in a sequence of centroids. This phase of our enquiry diverges in two directions. On the one hand, we have to consider the relations which centroidal and non-centroidal syllables sustain to one another as respects duration, whether that of equivalence, or of simple or complex proportion. This problem concerns the question of the “quantitative character of verse.” On the other hand, we have to consider centroids as recurrences, and determine whether the time intervals between them are equal. This problem deals with the question of the succession of the centroids.

Both of the above problems are phenomena of time. Much confusion has obtained with reference to their relations, in writings on the “time-theory of verse.” The signification of the term “quantity” has customarily been extended so as to become coextensive with all the time elements of rhythmical phenomena—succession, recurrence, duration, etc. “Quantity,” however, is a phenomenon of duration; succession, a phenomenon of intermittent recurrence. The two are separate and distinct, and should not be made interchangeable terms in speech. Duration is independent of repetition; repetition involves duration. Duration, as synonymous with quantity in speech, is an uninterrupted span; succession, a series of long or short spans.

¹ SUNDÉN, *Svensk Språklära*, 15, Stockholm 1895.

The specific task of the first enquiry is to measure the time occupancy of elementary sounds, centroidal and non-centroidal, and the gaps occurring between them (not pauses). The function of the latter, starting with this given manifold, is to determine the exactness of the coördinations of the intervals which occur between the momenta of rhythmical wholes; and to disclose the principles governing the rhythm of speech.

IV. THE MEASUREMENT OF SEPARATE SOUNDS AND SILENCES.

1. *Explanation.* Speech, structurally considered, is a complex synthesis of a number of formal unities. The following may be distinguished: (1) the unity of the poem or discourse, as a whole, governed by the principle of the unifying actus of the theme; (2) the unities of the sections and subdivisions, governed by the principle of the logical subordination of the parts to the whole; (3) the unities—the unities of speech par-excellence—of the particular groups of words or syllables which are separated from other groups by pauses, governed by the principle of the pause—punctuation-mark or non-punctuation-mark pause—and the expiration interval; (4) the unities of poetical verses, governed by the principle of the terminal pause; and (5) the more ultimate unities, consisting of separate sounds or syllables, governed by the principle of the silences or glides which separate them, as dependent upon the action of the vocal organs.

The first two classes of unitary groups are easily recognizable upon the printed page; in speech they are logically distinguishable. According to SWEET,¹ the only division actually made in language is that into "breath groups," corresponding to (3) above.

No account of the first and second kinds of unity has been taken in these experiments. The third (and the second in so far as it coincides with it) and the fourth receive separate treatment elsewhere. The fifth unity is the subject of this section.

The denial² of the existence of the unities of separate sounds and silences is founded upon a natural illusion. The unity of a grain of sand is for unaided discriminative visibility the grain as a whole; for science it is the particles composing the grain. For the eye it is one thing; for the microscope another. The only unitary sound groups in speech for unaided discriminative audibility may be the "breath groups." When the reproducing speed of the phonograph cylinder,

¹ SWEET, Primer of Phonetics, 42, Oxford 1890.

² SWEET, as before.

however, is sufficiently reduced these groups are split up into separate syllable groups.

The method by which separate sound unities are perceived is thus analogous to those used in perceiving ultimate sight unities, namely, to augment the quantity of the sensations by instrumentation.

The speed of the phonograph cylinder was reduced until a group of rapidly recurrent sounds, which had previously appeared as a homogeneity, was split up into discreet elements of sound separated by gaps. That is, psychologically these sounds and silences corresponded to a series of auditory sensations alternating with gaps or silences. It is the time of these several sensations, as well as the time of the intervals of silence between them, that was measured. Hence the terms separate sounds and silences are to be psychologically interpreted.

Physically, the sounds represent vibrations of given lengths, amplitudes and periods. The gaps or silences probably correspond in some cases to very weak vibrations (glides). Not infrequently, however, they are physically interpretable as absence of vibrations.

Physiologically, the sounds and silences are interpretable as changes in the condition of the vocal organs.

Owing to the degree of skill demanded by the difficulty of the work, the measuring was deferred to the later stages of the research. The words sometimes became so indistinct or transitory as to preclude measurement; but the instances were few, for the sounds, in reducing the rate of rotation of the cylinder, tended to become inarticulate before they became inaudible. A tone in order to be audible must consist of not less than approximately 16 vibrations per second. Theoretically, therefore, by slowing the speed sufficiently the lower pitches of the tones of the record would fall, as it were, below the threshold of audibility and become silent, before the higher pitches. The answer to this objection is that the degree of reduction was determined, not by the threshold of audibility, but by the threshold of articulability, which is higher than the former. Hence the sound which first became inarticulate determined the particular limit of the reduction.

The silences are indicated by dashes (—). The numeral below the dash indicates the duration of the silence in units of contacts; numerals above the syllables indicate the duration of the syllable to which they pertain. The unit of measurement in all the records is one contact, the value of which is $\frac{1}{32}$, $\frac{1}{37}$, $\frac{1}{40}$ or $\frac{1}{48}$ of a second, according as the recording speed was 80, 92, 100 or 120 revolutions per minute.

2. Records.

Subject, A. R. P. (Palmer, 1901.)

○ 15 ○ 15 ○ 11 ○ 25
 3 5 2 5 2 3 4 9
 My bed—is—like—a—little—boat ;—
 4 2 4 3 5 15

○ 15 ○ 18 ○ 14 ○ 19 ○ 48
 5 5 8 6 3 9 6 11
 Nurse—puts—me in—and I em—bark ;—
 8 5 4 3 33

○ 22 ○ 23 ○ 19 ○ 29
 2 7 6 6 8 4 8
 She—girds—me—in—my—sail—or—coat—
 ? 6 3 4 6 2 5 17

○ 21 ○ 14 ○
 And—starts—me—in—the—dark.
 ? ? ? ? ?

(Robert L. Stevenson.)

Unit of measurement, $\frac{1}{40}$ of a second.

Explanation and characterization of record.—The subject, an admirer of poetry, was told to declaim so as to make the record express his highest conception of good poetical declamation. No insight was given into the nature of the problem to be investigated. The stanza was recited from memory.

To the ear the record possesses the qualifications of good verse; the rhythm is markedly smooth, the modulation pleasing, and the centroids are emphasized with due discrimination.

Subject, W. C. (Churchill, graduate student.)

○ 20 ○ 28 ○ 9 ○ 17 ○ 23
 5 4 4 9 4 6 11 5
 Oh—yet—we—trust—that—some—how—good—
 2 4 7 7 6 3 5 9

○ 19 ○ 18 ○ 21 ○ 40
 6 4 3 6 4 13 3 14
 Will—be—the—fi—nal—goal—of—ill,—
 3 3 6 2 7 2 3 18

○ 23 ○ 27 ○ 24 ○ 45
 3 7 3 6 8 7 4 12
 To—pangs—of—nature,—sins—of—will,—
 2 7 5 13 8 4 24

○ 23 ○ 46 ○ 22 ○
 4 7 4 12 3 8 3 10
 De—fects—of—doubt,—and—taints—of—blood.—
 2 7 5 26 6 9 3

(Tennyson.)

Unit of measurement, $1/40$ of a second.

Explanation and characterization of record. The subject was given a printed copy of the stanza, and, after a reading, was asked to read it into the phonograph as poetry. The record sounds much like the previous, save that the rhythm is not so regular. No peculiarity is manifest in the relation of the elements of the centroid. The delivery sounds natural; the rate was rather fast.

Subject, J. M. T. (Telleen, graduate student.)

7	4	13	6	14	5	10	8
Take—the—joys—and—bear—the—sorrows.							
4	3	16	7	5	3		
3	7	11	6	6	4		
Shut—those—eyes,—next—life—will—							
5	6	14	6	6	?		
7	5	11	12	7	8		
open,—stop—those—ears,—next—life—							
?	7	4	33	7	6		
5	7	6	8	8	5		
will—teach—hearing's—office.							
5	13		5				

(Browning.)

Unit of measurement, $1/48$ of a second.

Explanation and characterization of record. The same method of taking the record was used as in the W. C. record. These two sentences are selected from the complete stanza, the first because of its regularity of structure, the second because of its consecutive centroids.

The rhythm sounds less regular than in the previous record. The syllables are distinctly uttered; the centroids receive a good share of duration emphasis. The movement is rather slower than the subject's ordinary speed of talking.

Subject, E. H. T. (Tuttle, 1901, student of phonetics.)

Perfect scansion.

(a) *Without regulative concomitant.*

○	24	○	31	○	20	○	33
4	5	6	12	6	10	3	11
And—so—no—force,—how—ev—er—great,—							
?	4	6	17	?	3	3	11
○	20	○	28	○	22	○	27
3	9	2	13	4	14	3	8
Can strain—a—cord,—how—ev—er—fine,—							
5	4	11	?	1	4	10	

○ 15 ○ 18 ○ 21 ○ 34
 2 7 3 8 6 8 5 22
 In to—a—ho—rizon—tal—line,—
 2 4 4 6 2 5

○ 22 ○ 21 ○ 24 ○
 3 7 4 6 3 7 4 11
 That—shall—be—ab—so—lute—ly—straight.
 ? 7 3 8 3 5 6

(b) *With regulative concomitant.*

○ 23 ○ 25 ○ 23 ○ 28
 ? 8 4 10 6 10 5 8
 And so—no—force,—how—ev—er great,—
 5 5 7 ? 7 12

○ 23 ○ 24 ○ 24 ○ 23 ○
 4 11 4 11 4 8 3 13
 Can strain—a cord,—how ev—er—fine,—
 6 7 4 7 9

○ 21 ○ 24 ○ 23 ○ 25
 2 5 5 12 5 9 11 ?
 In—to—a—ho—ri—zon—tal line,—
 ? 5 5 4 3 3 10

○ 22 ○ 22 ○ 24 ○
 That shall—be ab—so—lute—ly—straight.
 ? ? ? ? ?

Unit of measurement, 1/48 of a second.

Explanation and characterization of records. The subject was informed that the distinctive purpose of the experiment was to determine how accurately the intervals between the emphatic syllables could be coordinated. He was told to scan the selection with the utmost regularity, first, without and, second, with the aid of the finger beating time upon the table. The delivery was rather slow. A second purpose was to determine the relation which long and short syllables would assume. Of the latter purpose, no intimations were given.

To the ear, the first specimen sounds like an excellent example of routine scansion; the second sounds still more artificial and mechanical.

The two records differ not so much in the relation of the component syllables and silences as in the regularity of the intervals; hence only the measurements of the syllables and silences of the former, which is free from mechanical regulation, are given in the table of results.

Subject, W. L. P. (Phelps, Prof. English Literature.)

3 ○ ○ 8 9 ○ 4 12
 But—one—morning—the—min—i—ster,—
 3 4 ? 6 ? 4 11
 ○ ○ ○ ○ ○
 6 3 7 8 7 9
 in—the—chapel,—gave—out—
 5 ? 34 3 5
 ○ ○ ○ ○ ○ ○ ?
 6 21 10 7 8 3 ?
 the—hymn—num—ber—nine—ty-nine
 3 35 ? 5 6 2

Unit of measurement, $1/48$ of a second.

Explanation and characterization of record. The sentence is taken from the body of a prose record. The phrase rhythm is fairly-well preserved; the accents are normal, only one extra-long centroid occurring in the sentence. The rendition is distinct and emphatic.

(*Swedish poetry.*)

Subject, O. S. (Sandquist, age 13.)

16 22 19 25
 ○ ○ ○ ○
 5 10 4 8 3 11 5 5
 Ack,—Herre—Jes—us—hör—min—röst,—
 4 ? 4 5 3 5 9
 ○ ○ ○ ○ ○ ○ ○ 32
 5 9 4 8 3 7 ? 9
 Gör—dig—ett—tem—pel—i—mitt—bröst,—
 3 3 2 4 2 2 4 17
 ○ 18 ○ 18 ○ 18 ○ 19
 3 7 6 9 5 9 5 10
 U—ti—mitt—hjär—ta—blif—och—bo,—
 2 1 3 2 2 ? 3 9
 ○ 18 ○ 22 ○ 15 ○ 42
 Så har jag tröst och evig ro.

Unit of measurement, $1/32$ of a second.

Explanation and characterization of the record. The subject was chosen from a number of speakers who appeared on a children's program, because of the monotone fashion of speaking. The verses were recited from memory. They are end-stopped, with three sectional punc-

tuation marks. The sounds and silences could not be accurately measured in the last line. There was a general tendency to let the voice fall in pitch and weaken toward the close.

To the ear the stanza has a rhythmic swing characteristic of the jog-trot method of declaiming of many children. The degree of emphasis is moderate, considered especially duration-wise.

(*Persian poetry.*)

Subject, K. H. K. (Kazanjian, graduate student, philosophy.)

$\overset{\Delta}{\circ}_3$	3^o	$\overset{\circ}{\circ}_2$	23	\bullet	15	Δ	69	
11 5	6	7	9	5	7	14	9	7 . 8
Ahi min—el	askh—i	ve	ha—la	ti—hi				
5	5	6	?	4	1	6	?	25
$\overset{\Delta}{\circ}$	16	\circ	31	$\overset{\circ}{\circ}_2$	27	$\overset{\Delta}{\circ}$		74
8 7	3	10	4	7	7 12	6	5 5	
Eh—rak—i	kal—bi	be	hera—re	ti—hi				
4 2	5	4	6	?	7	4 2		32
$\overset{\circ}{\circ}_3$	31	$\overset{\Delta}{\circ}_2$	22	$\overset{\circ}{\circ}_2$	21	$\overset{\Delta}{\circ}_3$		71
11 8	6 8	10	5 7	7	11 6			9
Mo—naz—er—el	ayn—e	i—le	ghayri—kum—					
4 4	3 4	2 4	5		5			22
$\overset{\Delta}{\circ}_3$	32	$\overset{\circ}{\circ}_2$	29	\circ	20	\circ		
6 6	4 7	11	7 5	14	8 4	5		
Euk—sum—i—bil	la—hi	ve—I	yathihi.					
7 3 4	6 3 2		?					

Unit of measurement, $\frac{1}{8}$ of a second.

Explanation and characterization of record. The primary object in studying the record was to determine whether or not the accent in Persian poetry is entirely lacking, as alleged, or, if present, what is its essence; and the character of the rhythm. The reciter, a native of Persia, was told to exercise care lest the rendition might be affected by our occidental mode of utterance. The verses were recited from memory.

The movement is fairly rhythmical; the melody strikes the ear as weird and unfamiliar. On careful listening the centroids were evident to the ear.

3. *Sounds.*—a. *Historical summary.*—Two chief views have been advanced as to the temporal values of emphatic and unemphatic syllables. According to the one, the relation sustained is that of equality. There is no necessary bond between emphasis and duration. As a matter of

contingency or as dependent upon the difficulty of the physiological process of articulation, either syllable may arrogate to itself supremacy of time value.

The second theory, which has been held in three forms, posits a relation of long and short between the emphatic and unemphatic syllables. According to the first form the relation is indefinite and variable. In this form the theory is held by GURNEY,¹ GOOLD, BROWN, LOTZE,¹ BOLTON² and a host of others. For the most part, the relation, while fairly constant, is held to be inexact. LANIER³ may be taken as a representative of the second form, which maintains that the syllables of speech sustain a proportion of aliquot parts to one another. The proportion is always a simple one, such as 1, 2, 3, 4, 5, etc., and never fractional. According to the third form,⁴ the ratio sustained is precisely as 1:2. The theory is generally applied to classic verse, which theoretically admits but two time values, long and short, as obtaining among its sounds.⁵

b. *The measurement of emphatic and unemphatic syllables.*—The relative amount of time-occupancy of weak and strong syllables is shown in Tables V. and VI.

TABLE V.

Duration of emphatic syllables.

<i>Subject.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
A. R. P.	2.17	0.16	0.03	0.18	13
W. C.	3.50	0.20	0.05	0.25	17
J. M. T.	3.08	0.17	0.04	0.23	18
E. H. T.	3.27	0.20	0.05	0.25	16
W. L. P.	2.20	0.20	0.05	0.25	11
O. S.	3.06	0.25	0.03	0.12	12
K. H. K.	2.95	0.18	0.03	0.16	16
Av.	2.89	0.19	0.04	0.20	14.7

Unit of measurement, 1". *d*, total duration; *a*, average duration; *p*, immediate probable error; $\frac{p}{a}$, relative immediate probable error; *n*, number.

¹ GURNEY, *The Power of Sound*, 443, London 1880.

² BOLTON, *Rhythm*, Am. Jour. Psych., 1893 VI 34.

³ LANIER, *The Science of English Verse*, 73, New York 1880.

⁴ POE, *The Rationale of Verse*, Works, VI 60, Chicago 1895. Elsewhere he maintains a contradictory position, 52.

⁵ LANIER, *The Science of English Verse*, 113 New York, 1880.

ELLIS, *The Quantitative Pronunciation of Latin*, 8-20, London 1874.

TABLE VI.

Duration of unemphatic syllables.

<i>Subject.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
A. R. P.	1.15	0.10	0.03	0.30	11
W. C.	1.52	0.10	0.03	0.30	15
J. M. T.	0.93	0.11	0.02	0.18	8
E. H. T.	1.27	0.08	0.02	0.25	16
W. L. P.	1.31	0.13	0.04	0.30	10
O. S.	1.56	0.12	0.02	0.16	12
K. H. K.	3.85	0.13	0.02	0.15	28
Av.	1.65	0.11	0.025	0.23	15.7

Unit of measurement, 1° ; *d*, total duration; *a*, average duration; *p*, immediate probable error; $\frac{p}{a}$, relative immediate probable error; *n*, number.

(a) *Observations and conclusions.*—The tables of measurements point towards the following conclusions.

1. The absolute duration of any syllable is variable. The records reveal that the length of a given long or short syllable is never absolutely fixed: the precise length is different for every time it is spoken.

2. The average emphatic syllable is invariably longer than the average unemphatic syllable. The average of the former for all the records occupies 0.08 sec. more time than the average of the latter. The ratio is as 1.7 : 1; hence the average long syllable is almost one and three-fourths times as long as the average short syllable.

3. The ratio sustained between the average unemphatic and emphatic syllable varies with different subjects. The following are the ratios for each of the records, given in the order of the tables: 1 : 1.6; 1 : 2; 1 : 1.5; 1 : 2.5; 1 : 1.5; 1 : 2.08 and 1 : 1.38. With the exception of one record, all the average emphatic syllables are at least half again as long as the average unemphatic. The exception is the Persian; probably the element of duration is a property less prominent in the centroids of Persian poetry.

The highest ratio is furnished by the routine scansion record. Here the centroid syllable is two and a half times longer than the non-centroidal syllable. Scanned poetry thus appears to furnish the instance where the difference between the length of emphatic and unemphatic syllables is at its greatest. This suggests a conclusion with reference to the method in which classical Roman and Greek poetry was scanned.

The ratio in the prose record (W. L. P.) is slightly less than the average. Whether this is a valid distinction, as affecting prose and poetry, cannot, however, be maintained on the basis of this one record.

4. The ratios existing between individual emphatic or unemphatic syllables of the same or of different records, are neither invariable, nor are they ratios of simple proportion.¹ The possible relations, as may be seen by a glance at the records, and by an examination of the *p* column (the column of irregularity) are practically unlimited. Not infrequently the ratio is reversed, so that sporadic unemphatic syllables may be longer than the average of the emphatic syllables.

These facts incontestably refute the theory of "simple proportion." As an illustration, notice the following time relations in the consecutive syllables of the first line of the specimen of routine scansion, which, rhythmically considered, furnishes a type of poetry at its best: 0.083, 0.104, 0.125, 0.250, 0.250, 0.208, 0.062 and 0.229.

5. The long and short syllables are about equal in regularity. As respects the comparative amount of absolute irregularity, the average long syllable is one and six-tenths times more irregular than the short. The average amount of irregularity for each long syllable is $\frac{1}{400}$; for each short syllable, $\frac{1}{250}$. In proportion to the length of the span, however, the short syllable exceeds the long in the amount of irregularity by a trifle, namely, $\frac{1}{300}$.

6. The ratio between the number of emphatic and unemphatic syllables (exclusive of the Persian record) is as 1.2 : 1, which is smaller than the ratio between the total duration of the same. In none of the records are there less emphatic than unemphatic syllables, except in the Persian, where the numerical ratio is 1 : 1.75, and the duration ratio (the relative time-occupancy of all the emphatic and unemphatic syllables) as 1.33 : 1. The unemphatic syllables occur, as might be expected from the non-accentual theory of Persian poetry, one and three-fourths times as often as the emphatic. In English, however, the converse often occurs, as may be seen in the J. M. T. record. On the whole, the ratios between the duration and the number of long and short syllables do not coincide. The ratio between the latter may be equal; the ratio between the former is never that of equality for the total average duration of any record.

(b) *Bearing on the quantitative theory.*—The most general deduction to be made from this series of measurements is the disparity in the time-span of so-called short and long syllables. It has been shown that the temporal distinction is true to fact.

All speech is quantitative; and the distinction, popularly and confidently posited, between quantitative and non-quantitative verse, is grounded upon fallacious assumptions. The question of the quantitative character of poetry or prose, is closed. The only crux of contention that

¹ Cf. LANIER, *The Science of English Verse*, 73, New York 1880.

remains affects the character of the laws governing the temporal relation of the components of language. The question contains several phases.

The first determination has settled the fact that speech as a phenomenal occurrence is conditioned on the time-intuition of sensibility.

The second question has also been settled, namely that the strong syllable is temporally longer than the weak.

The third question is partly closed. It has been shown that for English, Swedish and Persian the ratio between the individual long and weak syllables is never constant. The general character of the ratio was, for artistically free declamation of English poetry, in the proportion of $1 : 1.7$; $1 : 1.38$ for Persian poetry; $1 : 2.08$ for Swedish poetry; $1 : 1.5$ for English prose; and $1 : 2.5$ for mechanical scansion.

It has generally been supposed that the ratio in classical verse is a fixed one, in the proportion of 1 to 2 . Supposing the theory true, what justification is there for setting classical verse apart as *sui generis*?

Evidently the distinction between so-called quantitative and non-quantitative poetry cannot be validated on the mere ground of proportionality, for our records have furnished examples of English and Swedish poetry in which the proportion is, respectively, as $1 : 2$, and as $1 : 2.08$; hence, if an examination of modern verse furnishes no support for the theory, on the basis of the *amount* of proportion (since it duplicates what the theory assumes as unique), the remaining alternative is to postulate a strict equality between each and every strong syllable and each and every weak syllable; that is to say, to suppose that the Roman and Greek ear was capable of exactly coördinating every individual emphatic and unemphatic syllable so that, relative to one another, they should sustain the proportion of $1 : 2$, and, regarded apart by themselves, a proportion invariably as $2 : 2$ in the former, and $1 : 1$ in the latter case. That such a proportion cannot be effected by the modern ear is indisputable. Even in the case of the strictest metronome scansion, the average inequality is 0.02° for every weak, and 0.05° for every strong syllable. When the modern ear is thus incapable of preserving the strict temporal equality of syllables, even in mechanical scansion, the quantitative theory as limited to classical poetry may, in regard both to *extent* and *invariability* of proportion, be considered exploded.

A third supposition is still possible, namely, that recited Greek and Latin verse, not improbably, was unique in the musical character of the utterance.¹ According to SYMONDS,² the poetry probably was sung or

¹ ELLIS, The Quantitative Pronunciation of Latin, 20, London 1874.

² SYMONDS, Sketches and Studies in Southern Europe, II 326, New York 1880.

chanted ; hence the tempo would have been an adagio, supposing ours to be allegro. This would naturally intensify the appreciation of the disparity in the durations of the two syllables, since more time would be afforded to the ear to listen to each syllable, and the quantity of sensation would be augmented. Hence the illusion would arise that the difference between classic and modern scansion of poetry lay in the relation of the weak and strong syllables, in respect of exact regularity and proportion, instead of in the relatively greater amount of time occupied by the syllables in classical scansion as compared with the non-classical, or reading, scansion of modern poetry.

The psychological explanation here advanced of the distinction between quantitative and non-quantitative poetry, as arising from a natural auditory illusion, seems quite compatible with the general psychological theory of illusions occurring in normal life.

(c) *Theoretical.*—How can we best account for the differences of duration existing between syllables?

The most prevalent theory may be called the physiological theory, which resolves the question into facility or difficulty of enunciation—into “lingual evolution.” Long syllables are those that are encumbered by consonants,¹ or those that contain long vowels²; and short syllables are those unencumbered by consonants, or those containing short vowels. Hence the conclusion that there is no quantity³ in English.

This theory undoubtedly explains a large percentage of cases. Some syllables, by reason of the vowels and consonants composing them, require a labored adjustment of the vocal apparatus, and hence a retarded utterance.

On the other hand, as was proved by the experiments of KRÁL and MARÉS,⁴ the addition of consonants does not proportionately or regularly lengthen the syllable ; it often shortens it. Moreover, the theory applies equally well to both weak and strong syllables, and is hopelessly inadequate to explain the large array of instances where syllables are normally or regularly long, although easy of articulation. It fails to render a satisfactory account of the fact that the average emphatic syllable is invariably longer than the unemphatic. Only the psychological theory can satisfactorily account for this circumstance.

¹ POE, *The Rationale of Verse. Works*, VI 59, Chicago 1895.

² GUEST, *A History of English Rhythms*, 103, London 1882.

³ GUEST, as before, v.

⁴ KRÁL A MAREŠ, *Trvání hlasek a slabik dle objektivné míry*, Listy Filologické, 1893 IV 17.

According to GURNEY¹ the long syllable occupies more time than the short, because the amount of effort required for its pronunciation is greater than that required for the short syllable. Another theory, partly physiological, partly psychological, attributes the prolongation to the fact that when a special intensification is made it is *accompanied* by a retardation of the action of the voice apparatus. It requires a longer period to overcome the contraction ; hence the sound is prolonged. Against this supposition it may be urged that the time required to *effect* the contraction is proportionately shorter ; hence a neutrality of effect.

The most fruitful theory, we believe, is the centroid theory advanced above. The centroid is a mental center of force, of which duration is an inseparable element. It is constituted a centroid by reason of the prominence, proportionate or unproportionate, which is given by the speaker to its properties. It is as natural to intensify the duration factor, as the pitch and loudness factors.

4. *Silences.—a. Explanation.* By silences is here meant those gaps which in listening to a slowly revolving phonograph cylinder, are perceived to exist between the successive syllables of phrase groups. The gaps between phrase groups, or expiration intervals, may be called, in contradistinction to the former, vacant intervals or pauses. It is only the former with which we are now concerned.

The popular idea, says SWEET,² that we make a gap between every syllable is erroneous ; the only phonetic divisions justifiable in speech are "those into sounds and syllables and intervening glides." It is patent, however, that the speech organs must consume a fraction of time in the transition from one sound to another, which will be long or short according to the inherent difficulty of the transition, and the amount of energy expended. A series of such transitions denotes, physiologically, a number of points at which the energy utilized by the organs of speech (diaphragm, lungs, larynx) may be considered to be at its lowest ebb ; and, physically, points at which the vibrations of the air are diminished in amplitude and frequency. When the diminution reaches a certain point the transitions become, psychologically, gaps or silences. The perception of these, however, is a distinct problem. According as the mind is intensely absorbed in the thought element of the utterance, the gaps fail to rise above the threshold of consciousness, and hence it is natural to suppose that an expiration group of syllables is psychologically a continuum. The illusion is exposed when attention is directed to the purèly structural aspect of

¹ GURNEY, *The Power of Sound*, 429, London 1880.

² SWEET, *Primer of Phonetics*, 42, Oxford 1890.

speech. The rapidity of ordinary utterance is so great as to render the elements of language too subtle for the processes of work-a-day analysis, and recourse must be taken to some means of aiding the power of mental analysis, namely, to magnifying the phenomena; this can be done by listening to a phonograph record, the rate of the rotation of the cylinder of which has been sufficiently reduced.

In a few instances it was impossible, in measuring, to detect any gaps between the syllables: they seemed to coalesce. In yet other instances, the gaps could be perceived, but were so indistinct as to make it hazardous to measure them. These instances are indicated in the records by a ?

In the table which follows a comparison is made between ante-, inter- and post-centroid silences. Only the average duration is given.

TABLE VII.
Duration of silences.

<i>Subject.</i>	—	↓	+
A. R. P.	0.103	0.200	0.103
W. C.	0.108	0.100	0.136
J. M. T.	0.095	0.139	0.104
E. H. T.	0.080		0.104
W. L. P.	0.079	0.072	0.111
O. S.	0.099		0.084
K. H. K.	0.086		0.078
Av.	0.092	0.127	0.102

Unit of measurement, 1^s.

—, silence preceding centroid.

↓, silence between centroids.

+, silence following centroid.

b. *Deductions.*—Owing to the limited number of silences upon which the determinations are based, the following are offered as tentative conclusions. Later researches may verify or modify them.

i. The silences that occur between centroids rank highest in the order of length.

It has been denied by GUEST¹ and affirmed by SWEET and MAYOR,² that two centroids can follow in an immediate sequence. The silence occurring between the contiguous centroids has been constituted the indispensable condition of such a series by some writers. GUEST, e. g., affirms (p. 86) that the condition of the immediate sequence of two accented monosyllables, is the intervention of a "pause." When the words are in groups, the law affects only the group.

¹ GUEST, A History of English Rhythms, 551, London 1882.

² MAYOR, Chapters on English Metre, 29 ff., London 1886.

The inter-centroid silence has been conceived in the nature of a pause. This is untenable. These silences are essentially the same as those which precede or follow centroids. The difference in duration between the averages is almost negligible— 0.025° .

2. The post-centroid occupies more time than the ante-centroid silence. The converse has been affirmed to be true by writers in phonetics.

3. The average duration of the silences of speech is about 0.107° .

5. *Comparison of the duration of sounds and silences.* (a) *Observations.*—The aggregate duration of all the sounds is equal to 31.82° ; of all the silences, 13.35° . The ratio of quantity of silence to quantity of sound is thus in the proportion of $1:2.38$.

This fact may contain material of importance of a psychological and physiological nature. It has been affirmed that the heart, for example, is alternately working and resting, resting between, working during, the pulsations. Similarly the alternation of sounds and silences suggest a constant alternation of work and rest on the part of the larynx.

There is this difference between the two cases. The period of work in cardiac action is about equal to, or slightly shorter than, the period of rest. In the action of the vocal cords, the period of work is nearly two and a half times longer than the period of rest. Obviously, this explains why the former mechanism is able to continue at work incessantly, while the latter requires long periods of rest for recuperating its energy. These periods are supplied partly by pauses, and partly by limiting the activity to a certain length of time, varying with each individual.

The above ratio is exclusive of pauses. In the later comparison of the various intervals of speech, the duration of the expiration intervals will be compared with the duration of the pause intervals.

None of the general averages of the silences is equal to the average duration of the centroid syllables. The average inter-centroid silence, however, is a trifle longer than the average short syllable.

(b) *Conclusions*—1. The quantity of the sounds of expiration intervals of speech is nearly $2\frac{1}{2}$ times greater than the quantity of the silences.

2. The average emphatic and unemphatic syllables of speech are both uniformly longer than the average silences.

V. THE MEASUREMENT OF INTERVALS IN SPEECH.

A. *Explanatory.*

No little confusion has obtained in the meaning ascribed to the term meter. Some writers employ the term to signify exactly regulated rhythm;¹

¹ ABBOTT AND SEELEY, English Lessons for English People, 146, Boston 1880.

others, the "foot,"¹ "measure,"² or "bar"; and others,³ the scheme whereby a fixed number of stresses at fixed points is marked out for the verse, whence we derive the terms dimeter, trimeter, tetrameter, pentameter and hexameter. According to POE,⁴ meter has to do with the number of feet, rhythm with the character of feet (the arrangement of syllables). Finally, meter has been made synonymous with the line⁵ or verse group, whence our "long" and "short" meter. This is the only kind of meter, or rhythm, recognized by Japanese and Persian prosody, the poetry of both of these languages having, theoretically, no accent.

GUEST⁶ provides, perhaps, the most comprehensive definition of the term. He makes it inclusive of three factors, according to the following scheme:

Meter	{ 1. Elements—syllables, verses, staves. 2. Accidents—quantity, accent, modification of sound. 3. Law of succession.
-------	--

Into a discussion of the propriety of these several views it is not our present purpose to enter. In so far as meter is synonymous with the verse and foot intervals, the two orders of meter will receive due consideration in the appropriate place.

The word verse is subject to a similar ambiguity. In prosody it is employed in three different senses: (1) A number of feet, or succession of words, constituting a metrical line. (2) A group of lines thus composed. (3) Metrical composition, as distinguished from prose.

The words foot, bar and measure are the popular words used to signify the intervals bounded by accented syllables.

The foot, in poetry, is generally defined as a succession of long and short or accented and unaccented syllables; the measure, as meter, or a rhythmical period; and the bar is a variant of the two. The first is exclusively applied to poetry; the second and third are also applied to music. In poetry they are generally employed as synonymous terms.

To designate the intervals of vacancy in speech the terms pause, rest, stop and silence are indifferently employed. The term rest finds favor in musical terminology; the word stop is synonymous sometimes with the punctuation mark and sometimes with the making of a change in pitch.

¹ MAYOR, Chapters on English Metre, 5 ff., London 1886.

² ARNOLD, A Manual of English Literature, appendix, Boston 1891.

³ GURNEY, The Power of Sound, 425, Lond. 1880; CORSON, ARNOLD, as before.

⁴ POE, The Rationale of Verse, Works, VI 56, Chicago 1895.

⁵ LANIER, The Science of English Verse, 234, New York 1880.

⁶ GUEST, A History of English Rhythms, London 1882.

The sound sequence enclosed within two pauses may perhaps be termed a phrase.

What is the common characteristic of these various groups of facts—the verse, foot, pause and phrase sequences? Obviously, they all agree as partaking of the same temporal and spatial characteristics. They are phenomena of duration. The term interval may be used as a general word to denote any of these sequences. A verse interval is thus a sequence consisting of a line of poetry.

An interval extends between the opening and closing point of a given sequence. Spatially, it is the distance between the first printed object and the last printed object of the sequence. To illustrate: a verse interval is the distance upon the printed page from the first syllable to, and inclusive of, the last syllable of the line. Temporally, it is the time which is consumed in speech in passing from the first to the last sound of the sequence.

In the collection of records to follow, the explanation of the centroid symbols is the same as on p. 15.

The words enclosed in () are inaudible on the phonograph record; those in [] were supplied by the subject.

The duration of the interval between any two centroids is indicated by the numeral which is placed midway between them. The measurements of the line and expiration groups are given only in the tables. Pauses marked ? are too indefinite for accurate measurement.

In the tables, "The immediate probable error" ρ is determined according to the formula :

$$\rho = \frac{2}{3} \sqrt{\frac{v_1^2 + v_2^2 + \dots + v_n^2}{n - 1}},$$

where v_1, v_2, \dots, v_n represent the differences that exist between each measurement and the average of all the measurements. The immediate probable error furnishes an expression for the amount of irregularity or inequality existing between the components of a series of measurements and the average of the series.

The "relative immediate probable error" $\frac{\rho}{a}$ furnishes an expression of the immediate probable error as a fraction of the average. It will be larger or smaller than the former according as the average is smaller or larger than the unit of measurement. The degree of regularity is expressed by this quantity.

Both the ρ and $\frac{\rho}{a}$ are measures of irregularity on the part of the subject. They are mental quantities. The inaccuracy of the average may be indi-

cated by dividing ρ by \sqrt{n} . This gives the "final probable error." It gives the limits within which the average of a similar set of measurements may be expected to vary with a probability of one-half.

The duration of the average interval may be represented to the imagination as a line of a definite length, *e. g.* ————— = 1^s. Every component of the given series of intervals will be either exactly equal to this line in length, *i. e.* 1^s, or will deviate from it in one of two directions—(a) plus (*e. g.* 1.50^s) or (b) minus (*e. g.* 0.50^s).

The *e* column gives for each record the lengths of the intervals which deviate the farthest from the average. Thus we get two kinds of extremes, — and +. The former represents the shortest component of the series, the latter the longest.

The *c* column gives the character of the difference of the greater of the two extremes from the average. To illustrate graphically:

$$\begin{array}{rcl} + & \text{—————} & = 2.^s \\ Av. & \text{—————} & = 1.^s \\ - & \text{—————} & = 0.50^s \end{array}$$

The middle line is the length of the average; the line above is the longest, and the line below the shortest, single interval in the series. The differences between the average and the + line is 1^s; the difference between the average and the — line is 0.50^s. Hence the character of the greater extreme is +.

The cipher indicates that the extremes are equal.

The following records are explained and characterized upon the basis of the impression made upon the ear. They are classified, according to the style of delivery, into four types of poetical scansion.

The rhythmically free declamation of poetry, or reading scansion, corresponds to the rhythmically free reading of prose. The one is the basal type of poetical speech; the other, of prose speech. The former admits of several distinct varieties, the latter of two or three less distinct varieties.

B. Records.

First specimen, J. W. R. (James Whitcomb Riley, poet, lecturer.)

○ 41 ♦ 29 ○ 30
They ain't no style about 'em,—

△ 31 ○ 30 ♂₂ 45 ♀₃ 67
And they're sort o' pale and faded ;—

45

○ 31 ♂₂₁₁ 42 ○ 25 ○ 28
Yit the doorway here, without 'em,—

10

○ 29 ♂₃₁₁ 87 ○₂ 22
Would be lonesomer,—and shaded

41

○ 19 ○ 32 ♂₂ 30 ♂₂ 22
With a good'eal blacker shadder

○ 23 ● 28 ♂₂ 28 △ ○ 50
Than the mornin'-glories makes,—

41

○ 31 ♂₂₁₀ 45 ○ 37 ♂₂₁₂ 40
And the sunshine would look sadder

○ 39 ♂₂₈ 38 ○ 34 ○
For their good old-fashion sakes.—

67

○₂ 43 ○ 37 ○₂ 28
I like 'em 'cause they kind o'

○ 23 ○₈ 26 ○ 20 ○ 75
Sort o' make a feller like 'em ;—

41

○₃₁₂ 20 ♂₂₈ 16 ●₁₁ 20 ○ 22 ○ 34
And I tell you, when I find a

○₂ 42 ○ 30 ○₂ 39 ○ 70
Bunch out whur the sun kin strike 'em,—

41

○₃₁₀ 37 ○ 40 ○₂ 23
It allus sets me thinkin'

○₂ 19 ○₁₈ 44 ♂₂₂₀ 44 ○₁₈ 43
O' the ones 'at used to grow,

○₂ 21 ○₂ 23 ○ 31 ○ 22
And peak in thro' the chinkin'

○ 23 ○₂ 25 ○₂ 25 ○
 O' the cabin,—don't you know.—
 ? 65

●₂ 36 ○ 26 ○₂ 64
 And then I think o' mother,—
 40

△ 18 ○₃ 20 ●₁₅ 28 ○ 53
 And how she used to love 'em,—
 ○ 24 ○₃ 42 △ 53
 When there wuzn't any other,—
 40

○? 37 ○₂ 27 ○ 24 △ 78
 'Less she found 'em up above (em)!—
 ○ 40 ●₂₃ 43 ○ 35 ○₂ 58
 And her eyes, afore she shut 'em,—
 44

○ 30 ○ 33 △₂₄ 46 ○ 22
 Whispered with a smile, (and) said—
 8

○ 34 ○ 26 ○₂ 55 ○₂ 19
 We must pick a bunch—and put 'em
 24

○ 27 ○₂ 74 ○ 32 ○
 In her hand—when she was dead.—
 37 69

○ 20 ○ 24 ○₂ 11 56
 But, as I was a saying,—
 12

○ 44 ○₂ 32 ○ 34
 They ain't—no style about 'em—
 8 19

●₂ 29 ●₂₅ 55 ●₁₂ 30 ○₂ 73
 Very gaudy or displayin',—
 53

$\overset{\circ}{\Delta}$ 34 \circ_2 20 ○ 27○ 6○
Yet I wouldn't be without 'em,—

40

○ 44 \circ_2 33 Δ 44 \circ_2 54
'Cause I'm happier in these posies,—
28

\circ_2 22○ 52 ○ 48
(And the) hollyhawks—and sich,—
15 39

○ 25 ○ 21 ○ 38 \bullet_{20}^3 36
Than the hummin' bird,—'at noses

15

○ 26 \bullet_2 49 ▽
In the roses of the rich.

(Old Fashioned Roses, Hoosier Dialect, J. W. Riley.)

Unit of measurement, $\frac{1}{48}$ of a second.

The poem was recited from memory. No suggestions were offered.

The style abounds in the pathetic and the grave. The movement is rather slow, with occasional diminuendos and crescendos and retarded and quickened pace. The melody and swing are peculiarly Rileyan. The rhythm is not continuous. The total effect upon the ear is pleasing.

The verses are largely end-stopped. Numerous sectional punctuation marks occur. Five stanzas were measured in order to obtain ample material for a study of the regularity of the verse intervals.

Second specimen, E. W. S. (Scripture.)

○ 17 ○ 21 \circ_2 31
The cities are full of pride,—
20

\circ_2 24 ○ 20 ○ 35
Challenging each to each—
29

$\overset{\circ}{\Delta}_2$ 28 ○ 23 ○ 27
This from her mountain side,—
16

\circ_2 20 \circ_2 19 ○
That from her burthened beach.

$\circ_2 \quad 21 \quad \circ \quad 29 \quad \circ_2 \quad 34$
They count their ships full tale—

15

$\circ \quad 24 \quad \circ \quad 25 \quad \circ_2 \quad 36$
Their corn and oil and wine,—

25

$\circ \quad 25 \quad \circ \quad 20 \quad \circ \quad 40$
Derrick and loom and bale,—

27

$\circ \quad 26 \quad \circ \quad 27 \quad \circ \quad 42$
And ramparts gun-flecked line,—

31

$\circ \quad 21 \quad \circ \quad 23 \quad \circ \quad 32$
City by city they hail :—

18

$\circ_2 \quad 19 \quad \circ \quad 23 \quad \Delta$
Hast aught to match with mine ?

$\circ \quad 13 \quad \Delta \circ_2 \quad 21 \quad \circ \quad 27$
And the men that breed from them—

12

$\circ 15 \quad \circ \quad 18 \quad \circ_3 \quad 41$
They traffic up and down,—

25

$\circ_2 \quad 24 \quad \Delta \circ 18 \quad \circ 30$
But cling to their cities hem—

12

$\circ_3 \quad 23 \quad \circ \quad 17 \quad \circ_2$
As a child to the mother's gown.

$\circ \quad 25 \quad \circ_2 \quad 21 \quad \circ 41$
When they talk with the strange bands,—

29

$\bullet \quad 27 \quad \circ 20 \quad \circ \quad 42$
Dazed and newly alone ;—

24

$\circ \quad 25 \quad \circ \quad 22 \quad \circ \quad 43$
When they walk in the stranger lands,—

30

$\circ_2 \ 22 \ \circ \ 23 \ \circ \ 33$
By roaring streets unknown ;—

24

$\overset{\Delta}{\circ}_2 \ 26 \ \circ \ 26 \ \circ \ 39$
Blessing her where she stands—

20

$\circ_2 \ 19 \ \circ \ 19 \ \circ$
For strength above their own.

$\overset{\Delta}{\circ}_2 \ 17 \ \circ \ 24 \ \circ \ 28$
On high to hold her fame—

9

$\overset{\bullet}{\circ}_3 \ 30 \ \circ \ 21 \ \circ \ 39$
That stands all fame beyond,—

26

$\circ \ 19 \ \circ \ 27 \ \circ \ 40$
By oath to back the same,—

24

$\circ_2 \ 26 \ \circ \ 19 \ \circ \ 54$
Most faithful-foolish -fond ;—

42

$\overset{\Delta}{\circ} \ 26 \ \overset{\bullet}{\circ}_2 \ 26 \ \circ \ 24$
Making her mere breathed name

$\circ \ 19 \ \circ \ 20 \ \circ$
Their bond upon their bond.

$\overset{\bullet}{\circ}_3 \ 19 \ \circ \ 29 \ \circ_2 \ 26$
So thank I God—my birth—

8 7

$\circ \ 17 \ \overset{\Delta}{\circ}_2 \ 27 \ \circ \ 32$
Fell not in aisles aside—

24

$\circ \ 12 \ \circ \ 15 \ \circ \ 16 \ \circ_3 \ 31$
Waste headlands of the earth,—

15

$\circ_2 \ 21 \ \circ \ 29 \ \circ \ 30$
Or warring tribes untried—

16

$\overset{\triangle}{\circ}_2$ 15 ○ 20 ○₂ 28

But that she lent me worth—
?

○₂ 19 ○₂ 21 ○

And gave me right to pride.

$\overset{\triangle}{\bullet}_3$ 27 ○ 26 ○₂ 25

Surely in toil or fray—

15

$\overset{\triangle}{\circ}_3$ 19 ○₂ 25 ○₂ 35

Under an alien sky,—

24

$\overset{\triangle}{\circ}_3$ 18 ○ 19 ○₂ 24

Comfort it is to say : —

II

○ 24 ○ 22 ○

Of no mean city am I.

(Dedication to the City of Bombay, Kipling.)

Unit of measurement, $\frac{1}{48}$ of a second.

The first two stanzas were declaimed from memory ; the others were read from the book. The verses are end-stopped. No sectional punctuation marks occur.

The record is typical of the subject, especially as regards emphasis, distinctness of articulation and rapidity of utterance. The point which most impresses the ear is the preservation of the rhythmic flow, both in respect of the recurrence of the centroids and the equality of the verse intervals. The last stanza has a peculiar jog-trot swing ; it will be used in the study of sing-song rhythm. The rhythm of the other stanzas is, in places, so pronounced that the record could have been subsumed under the head of doggerel scansion. The thirty-five lines furnish ample material for studying the verse interval rhythm.

Third specimen, A. D. B. (Bissell, musical composer, graduate student.)

(A.)

$\overset{\triangle}{\bullet}_2$ 23 ○₃ 32 ○ 38 ○₂ 36

Over the chimney—the night-wind sang—

7

15

○₃ 25 ○ 22 ○ 13 ○ 13 ○₂ 77

And chanted a melody—no one knew ;—

$\Delta_2 \quad 22 \quad \Delta_3 \quad 32 \circ \quad 15 \quad \circ \quad 27 \quad \circ \quad 38$
 And the woman stopped,— as her babe she tossed,—
 $23 \qquad \qquad \qquad \qquad \qquad \qquad \qquad 20$

$\circ \quad 18 \quad \circ \quad 38 \quad \bullet_2 \quad 55 \quad \bullet \quad 60$
 And thought of the one she had long since—lost,—
 $18 \qquad \qquad \qquad 38 \qquad \qquad \qquad 60$

$\circ_2 \quad 65 \quad \circ_2 \quad 34 \quad \circ_3 \quad 29 \quad \circ \quad 81$
 And said,—as her tear-drops—back she forced,—
 $38 \qquad \qquad \qquad 8 \qquad \qquad \qquad 55$

$\circ_3 \quad 34 \quad \circ_2 \quad \qquad \qquad 40 \quad \circ$
 “I hate—the wind—in the chimney.”
 $13 \qquad \qquad \qquad 15$

(What the Chimney Sang, Bret Harte.)

(B.)

$\circ \quad 25 \quad \circ_2 \quad 30 \quad \circ_3 \quad 30 \quad \circ_2 \quad 27 \quad \circ \quad 40$
 Though the mills of God—grind—slowly,—
 $17 \qquad \qquad \qquad 18 \qquad \qquad \qquad 22$

$\circ_1 \quad 22 \quad \circ_2 \quad 39 \quad \Delta_2 \quad 33 \quad \circ \quad 71$
 Yet they grind exceeding—small ;—
 $? \qquad \qquad \qquad 56$

$\circ \quad 28 \quad \Delta_3 \quad 41 \quad \circ \quad 29 \quad \circ \quad 42$
 Though with patience—He stands—waiting,—
 $15 \qquad \qquad \qquad ? \qquad \qquad \qquad 27$

$\circ \quad 26 \quad \circ_2 \quad 43 \quad \circ \quad 29 \quad \circ$
 With exactness—grinds He all.
 $20 \qquad \qquad \qquad$

(Retribution, Longfellow.)

Unit of measurement, $\frac{1}{48}$ of a second.

The first stanza was recited from memory; the second, from the book. The subject was uninstructed. The verses are end-stopped, with sectional pauses.

The record presents a variety of smooth and rugged movements. The swing in some phrases is almost pendulum like. The centroids are well emphasized. The subject was intent, apparently, on forcibly and artistically expressing the thoughts, rather than guarding against interruptions in the flow. The movement is rather slow.

Fourth specimen, W. W. (Wallin.)

$\circ \quad 21 \quad \bullet_2 \quad 44 \quad \bullet_3 \quad 23 \circ \quad 26 \bullet \quad 43 \quad \bullet_3 \quad 19 \circ \quad 43$
 The sky is changed!—and such a change!—Oh night,—
 $34 \qquad \qquad \qquad 35 \qquad \qquad \qquad 19$

\bullet_3 50 \bullet_3 42 ○ 17 ○ 31 ○ 43

And storm—and darkness,—ye are wondrous strong,—
21 11 28

Δ_3 18 ○ 32 ○ 2 43 \bullet_{16} 20 \bullet_{17} 28 ○ 30

Yet lovely in your strength,—as is the light
33

\bullet_{11} 14 \bullet_{13} 24 ○ 45 ○ 20 ○ 32

Of a dark eye in woman!—Far along,—
35 13

○ 23 ○ 35 ○ 22 ○ 25 \bullet_{11} 36

From peak to peak,—the rattling crags among—
18 25

Δ_3 27 ○ 18 \bullet_2 55 ○ 24 Δ_{10} 14 \bullet_2 36 ○ 30

Leaps the live thunder!—Not from one lone cloud,—
30 18

○ 16 \bullet_{10} 25 ○ 18 ○ 21 ○ 43

But every mountain now hath found a tongue,—
23

\circ_3 16 ○ 35 ○ 20 ○ 20 \bullet_{10} 43

And Jura answers,—through her misty shroud,—
14 32

○₂ 28 ○ 21 ○ 41 ○ 19 ○ 33 ○

Back to the joyous Alps,—who call—to her—aloud!
22 ? 22

\circ_2 17 ○ 14 ○ 80 \bullet_{21} 41 ○₂ 54

And this is in the night:—Most glorious night!—
45 44

Δ_{10} 12 ○₂ 11 ○ 11 ○ 22 ○ 58 Δ_{12} 14 ○

Thou wert not sent for slumber!—let me be
37

18 \bullet_3 28 ○ 15 \bullet_3 36 \bullet_2 17 ○ 53

A sharer in thy fierce—and far delight,
10 40

\circ_2 30 ○₂ 28 ○ 15 \bullet_{11} 51

A portion of the tempest—and of Thee!—
18 39

How the lit lake shines,—a phosphoric sea,—
 30 28
 And the big rain comes dancing to the earth!—
 38
 And now—again—'tis black,—and now,—the glee—
 20 15 40 8 23
 Of the loud hills—shakes with its mountain mirth,—
 52 45
 As if they did rejoice—o'er a young earth-quakes—birth.
 18 15 48 20 12 54 0

(Childe Harold Byron.)

Unit of measurement, $\frac{1}{48}$ of a second.

748

The stanzas were chosen as typical examples of Byronic vigor. The record strikes the ear as aiming more at painting the scene than moving in measured strides. The rhythm is vague. Several glides occur. The centroids are emotional, rather than logical. The elements of pitch, intensity and duration are each quite conspicuous. The verses afford an interesting study of the sectional and end-line pauses; several are run-on, with sectional pauses. Several of the larger punctuation marks occur within the line.

*Fourth specimen, J. K. (Kawabe,
graduate student, philosophy.)*

○ 16 ○ 19
Kimiga yo wa—
?

Chiyo ni yachiyo ni—
?

\odot_2 12 Δ 18 \odot_2 13
Sazare ishe no—

Δ
Os 25° 20'

○ 8 ○₂ 10 ○ 10 ○₂
Koke no musu made.

(National poem of Japan.)

Fifth specimen, I. M. (Miyake,
graduate student, psychology.)

○ 9 ○ 9 ○ 17
Kimiga yo wa—
?

Chiyo ni yachiyo ni—
?

Sazare ishi no—

39

?

o 15 o 11 o 11 o₂

Koke no musu made. 52

Unit of measurement, $\frac{1}{48}$ of a second.

The numerals following each verse indicate lengths of the lines.

Both subjects are natives of Japan. The poem was recited (chanted) and declaimed, strictly following Japanese usage. The above are the records of declamation and not of song.

The line meter strikes the ear as being perhaps more prominent than the centroid or "foot" meter. Theoretically, Japanese poetry is non-accentual. The centroids, however, were easily located by the experimenter, and the result was verified by the judgment of J. K. Japanese admit emphasis, as distinguished from accent, but make the distribution wholly arbitrary. It will be seen, however, that both records correspond in regard to the location of the centroids, with the exception of one instance.

The only meter which Japanese prosody recognizes is the line meter, the above consisting of an alternation of the five-syllable with the seven-syllable type. The five verses constitute one sentence.

The following is a free English rendering of the poem: "May thy throne last forever, until the sands shall become rock and mosses shall grow thereon."

Sixth specimen, H. Ö. (Öhrnstedt, age 12).

\textcircled{O}_2 20 0 27 \triangle 0 20 0 38
Han sig en hjord—församla vill,—
12 18

Δ
190 20 0₃ 200 55
Den himmelriket—hörer till.—
? 33

Δ
 \odot_3 22 ○ 20 ○₂ 20 ○ 37
Och himmel skall förgås och jord,—

⊕₃ 200 19 ⊕₂ 200 42
Men ej hans helga dyra ord,—
22

$\overset{\Delta}{\textcircled{O}_3}$ 22 021 $\overset{\Delta}{\textcircled{O}}$ 21 0
Hans namn af alla tungorsljud—

39 o 21 ▲ 20 o 20 o
Skall kallas Frälsare och Gud.

Unit of measurement, $\frac{1}{40}$ of a second.

The record was taken for the purpose of studying sing-song. The rhythm is very marked.

The end-stopped verses predominate. No intra-line punctuation marks occur.

Seventh specimen, O. S. (Sandquist, age 13).

O 20 O 22 O 19 O 26
O. Jesu Krist—att nalkas dig—
?

○ 16 ○ 19 ○ 39
Och dig i tro tillbedja,—
18

○ 21 ○ 21 ○ 20 ○ 26 ○ 26 ○
Det endast kan på sorgens stig—rätt innerlig—
19

For first stanza and explanation see p. 28.

This record furnishes an excellent specimen of the doggerel scansion so common to children.

Eighth specimen., G. A. A. (Andreen, lecturer; professor of Scandinavian languages.)

^② 16 o 16 [△] _② 27 [△] _○ 14 o 31 o 19 [○] ₃
Washington was a statesman of the highest order,—never a wily
18

19 \odot_2 15 0 11 \odot_2 42 0 16 Δ_{\odot_3} 20 Δ 20 Δ_{\odot_2} 10 0 25
scheming pol i tician.—When a cabal was formed—to remove him from
32 ?

the command and elevate Gates,—in perfect equipoise of mind and

○ 25 Δ_{\odot_2} 23 ○ 59 Δ_{\odot_2} 25 $\overset{\circ}{\Delta}$ 16 ○ 52
temper,—he moved not a finger.—Neither was he a brilliant orator.—

So that his excellence consisted not in show and glitter,—but in nobleness

of heart,—solidity of understanding,—and tenacity of purpose.—No
23 14 37

wonder then—that every American feels—as if it were true,—that “take

him for all in all,—we shall not look upon his like again,"—that none

do we more love to honor,—none so impresses our souls,—as he,—“the
23 23 15

first in war,—the first in peace,—the first in the hearts of his countrymen.”

Unit of measurement, $\frac{1}{48}$ of a second.

The address was read from the manuscript. The style was rhetorical; the utterances rapid and forcible. The subject was asked to make the record a typical address to an audience.

Tenth specimen, W. L. P. (Phelps, lecturer; professor, Eng. Lit.)

The class of ninety-nine—did not hold a very high reputation—as

○ 70 ○ 38 ○₂ 20 ● 27 ○₂ 80 ● 1 37 ○₃ 21 ○
scholars,—either for—study or for morals.—And it was notorious that
23 13 70

they paid no attention to the Sunday services;—but one morning, the
56

\odot_2 41 \circ 14 \odot_2 54 \circ 11 \circ 24 \bullet_{18}^3 55 Δ_{12}^2 22 \bullet_5^2 20 \bullet_8^3 84
minister,—in the chapel,—gave out the hymn—number ninety-nine! —

○ 20 △ 16 16 55 ○₂ 35 ○ 25 ○ 17 12 48 ○ 20
And with one accord,—the students of the class of ninety-nine—opened

the hymn book,—to find the place—and what was their amazement, on

○ 21 $\Delta_{\textcircled{3}}$ 20 \bullet_2 65 ○ 20 $\bullet_{\textcircled{1}}$ 16 \bullet 70 $\textcircled{1}_{\textcircled{2}}$ 25 $\bullet_{\textcircled{3}}$ 45
reading the first—line,—number ninety-nine ; — great—God ! — what
? 49 53 10 16

\odot_2 43 \odot_2
 $\frac{1}{4}$ 40 0
worthless—worms are we!

15

Unit of measurement, $\frac{1}{48}$ of a second.

The words were spoken extemporaneously. The movement is, on the whole, slow; the articulation distinct; the style colloquial. The sentences were punctuated by the speaker.

Eleventh specimen, C. O. S. (Scoville, clergyman, graduate student, philosophy.)

Almighty God, unto whom all hearts are open,—

•₂ 32 O₂ 25 •₁₄ 34 ▲₁₅ 28 ○ II ♀₇ 16 △ 34 . ○
all desires-known,—and from whom no—secrets are hid;
9 15 8

o 15 o 32 ^Δ₁₀ 14 o 16 o 45 o 34 o
worthily magnify— thy holy Name ;—through Christ—our Lord.

•
Lord,—let me know mine end, and the number of my
? 33 o 29 o 29 o 34

○ 20 ○ 21 ○ 110 28 ○ 28 ○ 24 ○ 58 ●
days:—that I may be certified how long I have to live.—Behold,
7 36

• 21 o 27 $\overset{\Delta}{\circ}_2$ 16 o 20 o 21 $\overset{\bullet}{\circ}_5$ 46 o 19 o 30 •
 age is even as nothing in respect of thee ;—and verily every man
 27
 $\overset{\Delta}{\circ}$ 25 $\overset{\Delta}{\bullet}_3$ 28 o 19 o
 living is al—together—vanity.
 ? 7

Unity of measurement, $\frac{1}{40}$ of a second.

Both prayers were read from the manual. The latter is offered at the burial of the dead. The movement is slow, the melody solemn, the intonation monotonous, the style that of devout consecration or solemn importation, and the rhythm quite manifest in certain phrases. The duration centroids are prominent.

Test records.—The rhythmic feeling has been asserted to be the most general æsthetic endowment of man.¹ Most people undoubtedly distinguish spoken verse from prose largely on the basis of this feeling. The external embodiment of verse (aside from the nature of the thought), that is, its verse and stanza-like structure as it appears in print, may be presumed, however, from the law of association, to play no inconsiderable part in lending support to the distinction. How, now, would the judgment of the individual be affected after the props of association have been removed? How would naïve, unsophisticated thought regard the distinction of prose and poetry into measured and unmeasured language.

To get at the uncritical, spontaneous judgment of the individual, the following test was devised :

The subject was conveniently seated before the phonograph, and was given a short passage in print, the contents of which were unknown to him, to be immediately read into the phonograph. He was urged to make his reading natural and representative.

Two devices were employed. In the first the subject was given a selection of poetry printed in the form of prose ; in the second, a passage of melodious prose printed as a stanza of poetry. In the latter case the subject was allowed to read the stanza through, before speaking into the tube, and was then told to read it according to his own discretion.

After the passage had been read the following questions were asked :

1. Did the passage, as you read it, sound familiar?
2. What did you spontaneously conclude regarding its form? If the question had never been raised, would you have taken it for granted that you read a piece of poetry or prose? What did you feel it to be?

¹ LANIER; GURNEY, as before, 128 ff.; BOLTON, as before.

3. Without engaging in reflective analysis, what do you instinctively feel to be at the basis of your judgment? Why poetry? Why prose?
4. Did the passage sound smooth or rugged as you were reading, or was it indifferent?
5. What did you feel these properties to be due to?
6. Did the passage sound melodious to you? If so, what does melody in speech mean to you? What are its elements?

Care was taken lest the subject should begin to unduly reflect upon the questions. Those judgments were rejected where the subject was familiar with the quotations. The questions were submitted to several persons from whom no records were taken.

The questions are in no wise to be considered as a statistical enquiry. They are only intended to reveal the state of consciousness, or the spontaneous judgments, of unsuspecting subjects.

After the answers had been given and the device exposed, the subjects of the first experiment were handed a copy in which the poetical quotation was printed in its original form,—that is, as poetry. The subjects were then asked to familiarize themselves with the contents, and read it as poetry. Thus it was possible to make a comparison of the two renderings by a study of the phonograph records.

A third device consisted in eliminating all the punctuation marks. The subject was not allowed to examine the passage before speaking it into the recording tube.

(a) *Records of verse.*

Twelfth specimen. J. M. T. (Telleen, graduate student, English.)
(A, without punctuation marks.)

Nothing henceforth—man's existence—bows—[bows] to the mo—ni—
tion wait take the joys and bear the sorrows neither with extreme con—
cern—living here—means nescience simply—'tis [the] next life—that

helps to learn—shut those eyes—next life—will open—stop those ears—
next life—will teach—hearing's office—close those lips—next life
17 11 23 17

next life—will teach—hearing's office—close those lips—next life
17 11 23 17

○ 16 ○ 35 ○ 35 ○
will give the power of speech !

(B, *read as prose.*)

○₂ 21 ● 15 ○ 14 ○ 21 ○ 25 ○₂ 28 ○ 7 ○ 26
Nothing!—Henceforth man's existence bows to the monition—
8 5 8

○₂ 32 ○ 18 ○₂ 28 ●₂ 29 ○ 30 ○ 12 ○₂ 32 ○ 20
wait! Take the joys and bear the sorrows—neither with extreme
23 13

○ 39 △₂ 10 ● 16 ○ 18 ○ 17 ○ 35 ● 12 ○ 11 ○ 23
concern!—Living here means nescience simply:—'tis next life that
26 25

○ 21 ●₂ 41 △₂ 11 ○ 10 ●₂ 32 ○ 12 ○ 20 ○ 41 ●₂ 36 ○ 9
helps to learn.—Shut those eyes,—next life—will open,—[those] stop
29 20 6 23

● 19 ○ 41 △₂ 20 ● 31 ○ 15 △₂ 24 ○ 40 ○₂ 8 ○ 7 ○₂ 37
those ears,—next life will teach hearing's office,—close those lips,—
27 27 25

△ 16 v 25 ○ 23 ○ 33 ○
next life will give the power of speech !

(C, *read as poetry.*)

○₂ 23 ○ 52 ● 20 ○ 20 ○ 26 ○₂ 35 ○ 23
Nothing!—Henceforth man's existence bows to the monition—
10 44 8

○ 43
wait!—
35

○ 17 △₂ 42 ○ 24 ○₂ 37 ○ 12 ○ 20 ○ 25 ○ 40
Take the joys—and bear the sorrows—neither with extreme concern!—
20 28 34

○ 18 ●₂ 26 ○ 15 △₂ 19 ○ 43 ○₂ 13 △₂ 13 ○ 24 ○ 20
Living here—means nescience simply:—'tis next life that helps to
? 30

○ 50
learn.—
42

△₂ 9 ●₂ 13 ●₂ 50 ○₂ 13 ○ 19 ● 48 ○₂ 12 ○ 17 ●₂ 46 ○₂ 12 ○
Shut those eyes,—next life will open,—stop those ears,—next life
34 33 37

30 ● 22
will teach

△ 16 ○ 50 △₂ 8 ○₂ 13 ○₂ 37 △₂ 12 ○ 28 ○ 27 ○ 36
 Hearing's office,—close those lips,—next life will give the power—of—
 37 28 ? ?
 ○
 speech.

(Browning.)

Unit of measurement, $\frac{1}{48}$ of a second.

Answers to questions.—1. No. 2. Prose. 3. Form of print. 4. Rugged. 5. The thought; loose rhythm. 6. No.

Thirteenth specimen. C. O. (Olson, graduate student, English.)

(A, *read as prose.*)

○₂ 32 ○ 30 ○ 22 ○ 29 ○₂ 29 ○₂ 9 ○ 21
 Nothing!—Henceforth man's existence—bows to the mon ition—
 18 6 11

○₈ 39 ○ 18 ○ 24 ○₂ 23 ○ 47 ○ 11 ○ 20 △ 21
 wait!—Take the joys and bear the sorrows—neither with extreme con-
 33 . 31

△ 46 ○ 14 ○ 16 ○ 40 ○ 26 ○ 41 ○ 12 △₂ 13 ○₂ 25
 cern!—Living here means—nescience simply:—'tis next life that
 38 27 26

○₂ 19 ● 39 ○₂ 12 △₂ 14 ○₃ 29 ○ 12 ○₂ 19 ○ 39 ○₂ 12 ○₂
 helps to learn.—Shut those eyes,—next life will open,—stop those
 31 18 25

11 ● 25 ○ 25 ○ 23 ○ 14 ○₂ 19 ○ 43 ○₂ 16 ○₃ 16 ○ 25 ○ 11
 ears,—next life will teach hearing's office,—close those lips,—next
 15 26 15

○₂ 24 ○ 12 ○₂ 25 ○₂
 life—will give the power of—speech.
 6 9

(B, *read as poetry.*)

○₂ 46 ○ 16 ● 18 ○ 21 ○ 26 ○ 29 ○ 21 ○₂ 41
 Nothing!—Henceforth man's existence—bows to the monition—wait!—
 30 10 10 32

○ 12 ○₂ 32 ○₂ 19 ● 51 ○₂ 9 ○ 17 ○ 22 ○ 49
 Take the joys—and bear the sorrows—neither with extreme concern!—
 15 32 35

△ 10 ○₂ 20 ○ 13 ○₂ 23 ○ 34 ○₂ 11 △₂ 12 ○ 20 ○ 18
 Living here means nescience simply:—'tis next life that helps to
 22

○ 42
 learn.—

\circ_3 8 ○ 9 \bullet_2 23 ○ 12 \circ_2 20 Δ_2 23 \circ_2 8 \bullet_2 12 \bullet_2 24 \circ_2 9 ○
 Shut those eyes,—next life will open,—stop those ears,—next life—
 9 18 9 31

47 ○ 21
 will teach—

II

Δ_3 16 ○ 41 ○ 8 ○ 9 ○ 26 Δ_3 12 \bullet_2 21 ○ 16 \bullet_2
 Hearing's office,—close those lips,—next life will give the power
 28 18
 of—speech !
 16

Unit of measurement, $\frac{1}{48}$ of a second.

Answers to questions.—1. No. 2. Dramatic prose. 3. Did not “feel” it to be poetry. 4. Smooth. 5. The movement. 6. Yes. Smoothness and movement.

Fourteenth specimen. G. F. A. (Abel, graduate student, philosophy.) (*Without punctuation marks.*)

\bullet_2 12 \bullet_2 17 \circ_2 30 \circ_3 29 ○ 37 \circ_3 19 ○ 17
 Henceforth man's existence—bows to the monition—wait—take the
 14 26 10
 \circ_2 25 \bullet_2 19 \circ_2 39 ○ 10 ○? 24 \circ_3 24 \circ_2 10 \circ_2 14
 joys and bear the sorrows—neither with extreme—concern—living
 25 8 ?
 ○ 18 ○? 11 \circ_2 22 ○ 52 \bullet_2 14 \circ_3 31 ○ 17 ● 41 \circ_2
 here means nescience—simply—'tis next life—that helps to learn—shut
 7 33 16 31
 $12 \circ_2$ 10 ● 22 \circ_2 10 \circ_3 15 ○ 36 ○ 9 ● 13 ● 37 \circ_2 12 ○ 19 ○ 10
 those eyes—next life will open—stop those ears—next life will teach
 8 25 24
 \circ_3 15 ○ 39 \bullet_2 12 \bullet_2 15 ○ 33 ○ 12 ○ 18 ○ 17 ○ 29
 hearing's office—close those lips—next life will give the power of—
 26 26 8
 ○
 speech !

Unit of measurement, $\frac{1}{40}$ of a second.

Answer to questions.—1. No. 2. Prose. 3. Arrangement of words; form; lack of rhyme. 4. First part, rough; second part, smooth. 5. Lack of meaning and punctuation marks. 6. Yes and no, as in 4. Rhythm, if anything.

Fifteenth specimen. W. C. (Churchill, graduate student, philosophy.)
(A, *read as prose.*)

o 18 o₂ 23 o 9 o? 15 o 23 o 16 o₂ 15 o₂ 17 o
Oh yet we trust—that somehow good will be the final goal of ill,

5

49 o₂ 23 o 24 o 21 o 53 o 19 o₃ 25 o₂ 21
—to pangs of nature,—sins of will,—defects of doubt,—and taints of
39 12 45 19

o 56 o₂ 21 o 30 o 21 o 57 o 11 o 14 o₂
blood;—that nothing walks—with aimless feet;—that no one life—
50 18 49 9

24 o 15 o 40 o 22 o 19 o 11 o 49 o₂
shall be destroyed—or cast as rubbish to the void,—when God hath
31 41

24 o 18 o 22 o
made the pile complete.

(B, *read as poetry.*)

o 20 o₂ 28 o 9 o₂ o₃
Oh yet we trust—that somehow—good—
13 ? 9

23 o 19 o₂ 18 o₂ 21 o 40
Will be the final goal of ill,—
37

o 23 o₂ 27 o 24 o 45
To pangs of nature,—sins of will,—
15 37

o 23 o 46 o 22 o 61
Defects of doubt,—and taints of blood;—
34 48

△₂ 18 o 23 o 20 o 48
That nothing walks with aimless feet;—
43

○₂ 10 o 13 o₃ 27 o 19 o 36
That no one life—shall be destroyed,—
11 33

o 27 o 22 o 14 o 48
Or cast as rubbish—to the void,—
? 34

o 26 o 23 △₃ 41 o
When God hath made the pile—complete.
16

(Tennyson.)

Unit of measurement, $\frac{1}{40}$ of a second.

Sixteenth specimen. B. S. G. (Gowen, college senior.)

(Without punctuation marks.)

○ 25 ○ 22 $\overset{\Delta}{\circ}$ 28 \bullet_2 17 \circ_2 29 ○ 14 ○ 16 ● 41 ○
Oh yet we trust that somehow—good—will be the final goal—of ill—
7 12 25 5

22 ○ 24 ○ 39 ○ 60 ○ 30 ○ 18 ○ 28 ○ 23 ○
to pangs of nature—sins—of will—defects of doubt and taints of blood
26 35 19

32 ○ 15 \circ_2 42 ● 19 ○ 35 ○ 8 $\overset{\Delta}{\circ}$ 13 ○ 23 ○
—that nothing walks—with aimless feet—that no one life—shall be
20 25 18 5

16 ○ 40 ○ 22 ○ 19 ○ 11 ○ 49 ○ 24 ○ 18
destroyed—or cast as rubbish to the void—when God hath made the
21 41

○ 22 ○
pile complete.

Unit of measurement, $\frac{1}{40}$ of a second.

Answers to questions.—1. No. 2. Prose. 3. "Felt" no rhythm. 4. Quite smooth. 5. Smooth succession of words; occasional rhythm. 6. In parts. Fitness of language to thought, and character of thought.

Seventeenth specimen. S. (Smith, laboratory mechanic.)

(A, *read as prose.*)

○ 19 ○ 25 ○ 24 ○ 17 ○ 18 ○ 19 ○ 17 ○
Oh yet we trust that somehow—good will be the final goal of ill,—
5 42

50 ○ 24 ○ 33 ○ 20 ○ 33 ○ 21 ○ 32 ○ 19
to pangs of nature,—sins of will,—defects of doubt,—and taints of
18 25 23

○ 37 ○ 18 ○ 30 ○ 23 ○ 50 ○ 11 $\overset{\Delta}{\circ}_2$ 12 ○
blood ;—that nothing walks with aimless feet ;—that no one life
32 39

21 ○ 32 ● 53 ○ 25 ○ 29 ○ 66 ○ 16
shall be—destroyed—or cast as rubbish—to the void,—when God hath
19 30 12 53

○ 20 ○ 23 ○
made the pile complete.

(B, *read as poetry.*)

○ 42 ○ 25 ○ 51 ○ 33
Oh yet—we trust that somehow—good
18 27

○ 20 ○ 21 ○ 34 ○ 58
Will be the final goal of ill,—
45

○ 26 ○ 45 ○ 20 ○ 34
To pangs of nature,—sins of will,—
29 27

○ 22 ○ 40 ○ 20 ○ 59
Defects of doubt,—and taints of blood ;—
25 43

○ 19 ○ 29 ○ 22 • 47
That nothing walks—with aimless feet ;—
? 29

○ 100 29 ○ 25 ○ 18 ○ 36
That no one life—shall be destroyed,—
7 22

○ 23 ○ 43 ○ ? 17 ○ 49
Or cast as rubbish—to the void,—
23 32

○ 29 ○ 19 ○ 24 ○
When God—hath made the pile complete.
7

Unit of measurement, $\frac{1}{40}$ of a second.

Answers to questions. 1. No. 2. Prose. 3. Felt little rhythm. 4. Not very smooth. 5. Form of expression. 6. Yes. Rhythm and vowel sounds.

Two other persons replied to the questions, but no records of their recitations were made. (B) 1. No. 2. Poetry. 3. Rhythm, rhyme and sentiment. 4. Smooth. 5. Metrical perfection, uniform length of words, avoidance of sibilants. 6. Yes. Meter, onomatopoetic words, ○ sounds, polished expression of sentiment. (C) 1. No. 2. Prose. 3. Form of print. 4. Smooth. 5. Rhythm and rhyme. 6. No.

The above two specimens of poetry are taken from the two foremost poets of the century just closed, the one standing for the highest metrical perfection, the other emphasizing the content rather than the formal investiture of thought. Each instance contains one case of run-on verses. The Browning selection, however, contains by far the greater number of intra-line punctuation marks.

To the ear the rhythm of the prose and poetry renderings appears to be about equally balanced. Appeal was made to several ears. On the

basis of the rhythm the attempt to distinguish the prose from the poetry in the readings did not prove very successful.

The movement in the records without the punctuation marks appears the most rugged. In these records the pauses strike the ear as if placed with diffidence and hesitancy.

(b) *Records of prose.*

Eighteenth specimen. S. I. (Isakson, stenographer.)

•₂ 19 ○ 26 ○ 13 ○₂ 20 ○ 47
To the poor Christian that sits bound in the galley ;—
28

○₂ 20 ○ 27 ○ 17 ○ 32 ○ 14 ○ 39
To despairful widows,—pensive prisoners,—and deposed kings ;—
13 12 29

○ 21 ○₂ 28 ○ 30 ○ 15 ○ 50
To them whose fortune runs back—and whose spirits mutiny—
7 21

○ 19 △₂ 23 ○ 29 ○ 14 ○ 17 ○
Unto such—death is a redeemer,—and the grave a place for rest.
9 10

(Essay on Death, Bacon.)

Unit of measurement, $\frac{1}{40}$ of a second.

Answers to questions.—1. No. 2. Poetry. 3. Form of print, easy movement, and beautiful sentiment. 4. Smooth. 5. Meter. 6. No.

Nineteenth specimen. O. E. S. (Staaf, graduate student, Latin.)

○₂ 11 ○ 28 ○ 13 ○ 70 10 ○ 38
To the poor Christian that sits bound in the galley ;—
21

○ 16 ○ 26 ○ 19 ○ 38 ○ 18 ○ 31
To despairful widows,—pensive prisoners,—and deposed kings ;—
12 14 20

△₂ 29 ○ ○ ○ 21 ○ 14 ○ 17 ○ 43
To them—whose fortune runs back and whose spirits mutiny—
8 15

○₂ 21 ○ 25 ○ 29 ○ 15 ○ 15 ○
Unto such—death is a redeemer,—and the grave a place for rest.
14 10

Units of measurement, $\frac{1}{32}$ of a second.

Answers to questions.—1. No. 2. Poetry. 3. Meter, outward form. 4. Neither. 6. No.

Answers to questions were obtained in several cases without taking phonograph records. (D) 1. No. 2. Poetry. 3. Periodic recurrence of accents. 4. Smooth. 5. Rhythm. 6. No. (E) 1. No. 2. Doubtful. First two lines poetry; last two lines upset judgment. 3. Rhythm of first two lines (poetry); prosaic thought (prose). 4. Feeling of smoothness gradually vanishing. 5. Correspondence of main stress-points in first two lines (3 each). 6. Yes. Rhythm. (F) 1. No. 2. Poetry. 3. Verse-like structure, inversion, a certain rhythm. 6. Yes. Don't know. (G) 1. No. 2. Poetry. 3. Mechanical form and poetic sentiment. 4. Smooth. 5. ? 6. Yes. (H), poet 1. No. 2. Rhythrical prose. 3. No meter. 4. Smooth prose. 5. Swinging movement. 6. Yes. Graceful expression of thought, alliteration and interior rhymes. (I) 1. No. 2. Poetry. 3. Meter and poetic language, especially the second line. 4. Not altogether smooth. 5. Smooth flow. 6. Yes. Pleasing sounds. (J) 1. No. 2. Both. Lines 2 and 4, poetry; lines 1 and 3, prose. 3. Rhythm and lack of rhythm. 4. Lines 2 and 4, smooth. 5. Rhythm. 6. Yes. ?

The second specimen of rhythmical prose arranged as a stanza of poetry is found on p. 26. The questions elicited the following replies: (K) 1. No. 2. Poetry. 3. Rhythm. 4. Smooth. 5. Regular recurrence of accents. 6. Vague feeling of melody. (L) 1. No. 2. Poetry. 3. Regularly recurring accents (primarily), rhyme, printed form. 4. Fairly smooth. 5. Rhythm. 6. No. (M) 1. No. 2. Poetry. 3. Rhythm and rhyme. 4. Smooth. 5. Uniform number of syllables to line. 6. Yes. Rhyme. (N) 1. No. 2. Prose printed as verse. 3. Subject-matter prosaic. 4. First part smoother. 5. Rhythm and rhyme. 6. No.

The judgments were derived from persons who, according to admission, possessed more or less poetic appreciation. Nearly all were admirers of music and the majority possessed some knowledge of its rudiments. The answers throw some light on the varied manifestation of the instinctive or native appreciation of rhythm, smoothness and melody in speech. The connotation of the term melody of speech is in most people's minds shifting and vague. This is suggested by the answers and by a cursory glance at the popular discussions of the subject. The word answers, in most people's minds, to no fixed conception. To most subjects it is interchangeable with rhythm (motion); to some, with vowel sounds, rhyme and alliteration (tone-color); to others, graceful and fit expression of thought; and yet to others the term has no signification.

The connotation of the term smoothness of speech is more fixed than that of melody. This quality was felt to be due to the quality, first, of

the movement, and second, of the sound. In some cases no definite notion corresponded to the term; in others, no smoothness was felt. In some of the latter cases, as was noticed by the experimenter, the reading was rugged.

The success of the deception varied. Three subjects declared the verses of Tennyson and Browning to be prose. The reasons given were "lack of rhythm," "form of print," "indefinite." Only one subject pronounced the verses of Browning, and two the verses of Tennyson, poetry. All the judgments were based on the feeling of rhythm. Six subjects called the prose sentence of Bacon poetry. The reasons given were the outward form, sentiment, poetic language, inversion of words, or rhythm. One subject was doubtful, one pronounced the sentence half-and-half and one (a poet) pronounced it, correctly, rhythmical prose. The specimen of mathematical prose was declared to be poetry by three subjects on the basis of rhythm, rhyme, or the form of print; and to be prose written as verse by one on the basis of the prosaic subject matter.

Some of the subjects, who felt no rhythm in the lines, pronounced the passages smooth, others feeling no smoothness pronounced the lines rhythmical.

The following corollaries, to be held tentatively, are deducible from a comparison of the judgments:

(a) Poetry is spontaneously and instinctively distinguished from prose most largely upon the basis of a rhythmic affection of sensibility. All other differences, such as inversion, sentiment, rhyme, etc., are subordinate.

(b) For unsuspecting and naïve thought, the arrangement of the words into verses and stanzas serves as an important prop for differentiating the rhythms of prose and poetry. The removal of this support tends in the majority of cases to convert the rhythm of poetry into the rhythm of prose, and vice versa.

(c) The rhythmic instinct is an affection of sensibility, varying to some extent with individuals. It has two aspects—motor and sensory. The test concerns only the former—the rhythm felt by the subject in uttering and not in hearing uttered a series of words. As a motor phenomenon the instinctive perception of the rhythmical time sense is subject to variations in the immediacy of response and in the universality of manifestation. This is most obviously dependent upon the degree of development of the power of coördinating time-units.

We begin now the detailed examination of the quantitative determination of the various groups of recurrences. The verse intervals will most conveniently be dealt with first.

C. Verse intervals.

The term verse is used in this discussion as synonymous with a line of poetry. The verse interval signifies the interval of sound which constitutes a run-on or end-stopped line of poetry. It is the time required in speaking to pass from the first to the last sound of the line.

The measurements are made from the beginning of the first to the end of the last sound of the verse. The pauses at the end of the verses are not included in the measurements. Hence the determinations yield a measure of the length and inequality of the verses only.

TABLE VIII.

(Poetry.)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. W. R.	2.20	0.36	0.15	+ 3.18 — 1.56	+	32
E. W. S.	1.15	0.09	0.07	+ 1.39 — 0.89	—	36
A. D. B. A.	2.41	0.30	0.12	+ 3.14 — 1.91	+	6
W. W.	2.95	0.45	0.15	+ 4.04 — 1.87	+	18
A. R. P.	1.63	0.21	0.12	+ 1.92 — 1.35	+	4
H. Ö.	2.05	0.12	0.05	+ 2.25 — 1.67	—	8
O. S.	1.87	0.12	0.06	+ 2.12 — 1.53	—	7
Av.	2.05	0.23	0.10			

TABLE IX.

(Poetry read as prose.)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>c</i>	<i>n</i>
J. M. T.	4.14	0.50	0.12	+	5
C. O.	3.92	0.30	0.07	+	5
W. C.	1.74	0.13	0.07	—	8
S.	1.66	0.12	0.07	—	8
Av.	2.86	0.26	0.08		

TABLE X.

(Poetry read as poetry.)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>c</i>	<i>n</i>
J. M. T.	4.62	0.55	0.11	+	5
C. O.	3.84	0.24	0.06	+	5
W. C.	1.92	0.23	0.12	—	8
S.	2.39	0.26	0.10	+	8
Av.	3.18	0.32	0.09		

TABLE XI.

(Prose read as poetry.)

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>c</i>	<i>n</i>
S. I.	2.85	0.27	0.09	+	4
O. E. S.	3.53	0.31	0.08	-	4
Av.	3.16	0.29	0.08		

TABLE XII.

(Summary of TABLES VIII., IX., and X., poetry.)

<i>Table.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$
VIII.	2.05	0.23	0.10
IX.	2.86	0.26	0.08
X.	3.18	0.32	0.09
Av.	2.69	0.27	0.09

Unit of measurement, 1^s .*a*, average duration.*p*, immediate probable error. $\frac{p}{a}$, relative immediate probable error.*e*, extreme intervals.*c*, character of greater extreme.

These observations are based upon a study of 163 verses, various as to length and structure.

Extreme intervals.—The longest interval among the 111 verses is 5.01^s , 4th verse, record of J. M. T.; the shortest 0.89^s , Table VIII., E. W. S.; a range of 4.12^s . This is applicable to verse intervals, similarly composed, in general, presupposing that the figures fairly well represent the extremes.

Character of extreme intervals.—Column *c* of Tables VIII., IX. and X. furnishes the following data bearing upon the nature of the largest extreme deviation among individual verses: 60 per cent. are extremes of excess, 40 per cent. of deficiency, and 0 per cent. of equality. The tendency is thus to cause the longest individual deviation to vary more than the shortest from the length of the average.

Average duration.—(1) *For the series.* The average for the series of 163 intervals is 2.69^s . For the series of records of prose read as poetry it is 3.16^s .

(2) *For the sets.* The shortest average of any set of records is 2.05^s , Table VIII., various types of scansion; the longest, 3.18^s , Table X., poetry read as poetry, making a range of 1.13^s for the average verse intervals of the different sets of records.

The average in the set of records where poetry was read as poetry is 0.32^s longer than in the records where poetry was read as prose.

The average in the set of records where prose was read as poetry is

0.04^s longer than the average of Tables IX. and X. (test records), and 0.11^s longer than in the set of records of Table VIII. (poetry).

(3) *For the records.*—The longest average for any record is 4.62^s, J. M. T., Table X.; the shortest, 1.15^s, E. W. S., Table VIII.; a range of 3.47^s. These figures presumably represent the time limits within which the average verse interval, similarly composed, of any reciter will fall.

The range for different records appears to be nearly three times larger than the range for different sets of records; and the range of the individual verses is about 1.29 times the range existing between the average intervals of different records.

Relative inequality.—(1) *For the series.* The inequality for the series of poetry is 9 % of the average duration of the intervals, and for prose, 8 %.

(2) *For the sets.*—The highest percentage is 10 %, Table VIII., types of scanned poetry; the lowest, 8 %, poetry read as prose, and prose read as poetry; a range of only 2 %.

(3) *For the records.*—The highest percentage among the individual records is 15 %, W. W. and J. W. R.; the lowest, 5 %. This gives a range at 10 % for different records. Every subject was slightly more regular in reading the poetry as prose than as poetry. The highest difference between the regularity of the two records of the same subject is 0.05 (W. C.); the lowest, .01 (J. M. T. and C. O.).

Importance attaching to the duration of the verse interval.—The verse is the longest interval with which these measurements are concerned; hence the relevancy of the following remarks.

The interest that attaches to the length of the verse-group arises chiefly from a consideration of the span of the rhythmic time sense. How long a period is consciousness capable of rhythmizing? How short or how long must the unit be to enable the mind to coordinate it with other units of the same kind?

GURNEY¹ holds that the most highly developed rhythmic sense can take in no more than a "small group"; and SIEVERS² and SCHMIDT,³ equally vague, "strictly limit" the length of the sentence so that the time occupied in reading it may constitute a rhythmical whole. BOLTON⁴ concludes from experiments on subjective rhythmisation that there is a correspondence between the average time of a rhythmical unit, no matter

¹ GURNEY, *The Power of Sound*, 127, London 1880.

² SIEVERS, *Grundzüge der Phonetik*, 4. Aufl., 218, Leipzig 1893.

³ SCHMIDT, *Introduction to the Rhythmic and Metric of the Classical Languages*, 79ff., Boston 1878.

⁴ BOLTON, *Rhythm*, Am. Jour. Psych., VI 145-238.

what the form, and the normal wave of attention. The rate of speed determined the form, or the number of the components (8, 6, 4, or 2), of the group. No matter what the number, within certain limits, of the impressions, the duration of the group remained relatively the same, about 1° . He gives 1.5° as the upper limit.

It seemed that the natural period of attention exercised a regulative influence upon, and definitely limited the span of, the groups.

LANGE¹ found that the periodicities of the maxima and minima of attention for acoustic sensations varied from 3.5 to 4.0° ; for optic, from 3.0 to 3.4° ; and for electrical cutaneous, from 2.5 to 3.0° .

STEVENS² posits a time interval between 0.53° and 0.87° , which is capable of being reproduced with the greatest accuracy. A plus interval results in a plus error; and a minus in a minus error. JOHNSON,³ however, experimenting on practice and habit, concludes that there is no "indifference point" from which variations do not occur.

DIETZE⁴ reports that the subject of his experiments in rhythm was incapable of grouping the impressions after the period had reached 4.25° .

Other experiments have given the following results: for the MASSON disc, an average period of⁵ 3.5° (with average variation of 0.3°), and of about 5 or 6° ⁶ (with possible variation from 6 to 27° ⁷), the oscillation having been found most rapid⁸ with a certain difference between the grayness of the disc and the ring; for voluntary effort,⁹ a period of three-fourths of a second, attended by a large fluctuation and recovery; and for subjective rhythmisation of sounds, the "lower limit"¹⁰ of the intervals has been placed at less than 2° ; others give a limit of less than 0.4° ¹¹ and 0.5° ¹², and of more than 1.0° .¹³

¹ LANGE, *Beiträge zur Theorie der sinnlichen Aufmerksamkeit und der activen apperception*, Philos. Studien, 1888 IV 404.

² STEVENS, *On the time sense*, Mind, 1886 X 394.

³ JOHNSON, *Researches in practice and habit*, Stud. Yale Psych. Lab., 1898 VI 91.

⁴ DIETZE, *Untersuchungen über den Umfang des Bewusstseins bei regelmässig aufeinanderfolgenden Schalleindrücken*, Philos. Studien, 1885 II 383.

⁵ PACE, *Zur Frage der Schwankungen der Aufmerksamkeit nach Versuchen mit Masson'schen Scheiben*, Philos. Studien, 1893 VIII 394.

⁶ TITCHENER, *A Primer of Psychology*, 89, New York 1898.

⁷ TITCHENER, *An Outline of Psychology*, 141, New York 1896.

⁸ MARBE, *Die Schwankungen der Gesichtsempfindungen*, Philos. Studien, 1893 VIII 615.

⁹ SCRIPTURE, *The New Psychology*, 125, New York 1897.

¹⁰ SMITH, Philos. Studien, 1900 XVI 282.

¹¹ MEUMANN, Philos. Studien, 1894 X 302.

¹² MARTIUS, Philos. Studien, 1891 VI 196.

¹³ TITCHENER, *Experimental Psychology*, I, ii 340, New York 1901.

These figures indicate: (1) That, while the differences in the results of experiments may be partly explained by differences and inconstancy in the amount of the stimuli and in the physical and mental conditions of the observers (due to fatigue, inattention, irrelevant movements, sensations and memory images, passive or active attitude, etc.), the natural period of attention will differ for the different senses and for different individuals. The period for the more purely sensory (receptive) waves may also differ from the more purely motor (voluntary) waves; and those of involuntary subjective grouping from those of voluntary grouping.

(2) That the span of the rhythmic sense is definitely limited for each individual, though we do not yet know its precise upper or lower limits, nor how it differs in voluntary and involuntary subjective rhythmisation, in its sensory and motor aspects, nor its dependence on the psycho-physical conditions and age of the individual.

(3) That the regularity of intervals will be greater for those that fall within the span than for those that do not. This will be illustrated presently.

Rhythrical signification of irregularity of intervals.—The definition of rhythm entails a limiting conception, as regards both the span and regularity of intervals. What does the concept of rhythm require? Absolute or relative conformity to a standard? How great a variation may intervals admit of without becoming unrhythrical, or non-periodic?

A series of intervals of an average duration of 4.62^{s} (J.M.T.) manifestly will admit of more absolute variation than one of 1.15^{s} (E.W.S.). Hence the amount of variation expressed as a percentage of the average duration (the relative immediate probable error) yields the index of regularity. How small must this be to preserve the rhythmical unity of intervals?

This question emphasizes the distinction between hap-hazard recurrences and strict periodicities—between coordinated (that is, rhythmical) sequences, and uncoordinated (that is, unrhythrical) sequences. It is a mistake to subsume all recurrences¹ of maxima and minima, all repetitive undulations and oscillations, under the concept of rhythm, and treat literary, social, geological, *et al.*, phenomena as rhythmical. Prior to legitimately making such sweeping subsumptions a measure or limit to the irregularity for any series of occurrences must first be adopted. This involves the adoption of a *criterion of irregularity*.

It has been established, by facts admitting of profuse illustration,² that things come and go in waves and periods; that all motion is oscillatory

¹ SPENCER, First Principles, X, The Rhythm of Motion, New York 1883.

² FISKE, Outlines of Cosmic Philosophy, II.

and not uniform, either in the sense of continuing at precisely the same rate of motion, or invariably in the same direction. But undulations that are not well coordinated periodicities are mere recurrences.

The limit of irregularity cannot be fixed *a priori*. It may be determined by taking an easily rhythmisable series of intervals and increasing the inequality until the subject is incapable of rhythmising them. This practical test is based upon the fact that the feeling of rhythm is non-existent for me, until it becomes an affection of my sensibility. The only rhythm which can become an object of direct experience is that of a succession of psychoses. Hence the ultimate criterion is to be found in the sensibility of beings rhythmically constituted.

In the present investigation the limits may be approximately determined in units of time by ascertaining the average amount of inequality of those records the intervals of which the ear is incapable of coordinating.

Each record of Table VIII. was listened to a number of times, and the attempt made to coordinate the sequences of impressions representing the verses. The reproducing speed was relatively the same as the recording speed. Appeal was then made, where the rhythm was obscure, to the motor aspect of the rhythmical sense.

With reference to the more purely motor aspect of the attempted grouping, it was difficult to impart a very distinct unity to the verses of the J. W. R. and A. D. B. records, unless the lines were repeated rapidly and the terminal pauses were considerably prolonged. The rhythm then became marked. The verses of the W. W. record with this device, were capable of being only vaguely coordinated and grasped as totalities. These verses contain twelve syllables.

Listening to the records on the phonograph, it was difficult to co-ordinate, and grasp as rhythmical wholes, several of the verses of the J. W. R., and most of the W. W. record. In the A. D. B. records it was possible to feel a certain verse rhythm; in the A. R. P. record, it was more distinct; in the three remaining records it was marked, especially in the H. Ö. and in the last stanza of the E. W. S. record. In general, other things being equal, the shorter verses were more unitary and rhythmical.

Bearing upon the limit of inequality and span of the rhythmic sensibility.—These results suggest that when the deviation rises to a fraction of 15% of the length of the whole interval, the mind finds it hard to rhythmise the impressions; when the fraction is 12% the rhythm is still a little vague; and when it is 7% the intervals are easily coordinated. When the fraction is smaller, of course, the rhythm becomes increasingly distinct.

As regards units of time, the rhythm of the verse intervals was almost

destroyed when the deviation reached a third of a second ; it was somewhat disturbed when it reached a fifth of a second ; and when it was about one-tenth of a second, it was well preserved.

From the measurements of the irregularity of the verse intervals, it is difficult to determine the maximum length of an interval that can be synthesized into a rhythmical whole. The longest span where the rhythm was felt, though vaguely, was 2.41^s ; except in the Persian record, where the line meter rhythm was very distinctly felt and the intervals averaged 2.45^s . Here the absolute irregularity and relative irregularity reached the low figures of 0.06^s and 0.02 respectively. That the Persian line group should manifest a relatively high degree of regularity was to be expected *a priori* from the Persian theory of poetry. In Japanese poetry, which theoretically follows the same law with respect to its meter, the irregularity is 0.06^s for J. K. (av. length of verses = 0.87^s) and 0.09^s for I. M. (av. = 0.95^s), and the fraction is 0.07 and 0.09 respectively. While, therefore, the verse meter of both these languages conforms with the requirements, as respects degree of regularity, of rhythm, the records show that English poetry, which theoretically does not recognize the verse meter, except as secondary, affords specimens which surpass the Japanese in regularity and which, if we include the record of mechanical scansion without regulative concomitant where the figures are 0.06^s and 0.03 , are practically equal to the Persian. No other intervals in the records of the oriental languages are equal to the regularity of the verse intervals. (In the Persian record the expiration and the verse intervals coincide.) In English the simple centroid intervals are frequently as regular.

The long limit of the rhythmic sense for verse intervals, themselves containing minor intervals (rhythms), probably does not generally exceed two and a half seconds. Perhaps we may say that those of less than one and three-fourths of a second in length (with inter-verse pauses of average length) give for most subjects the best results rhythmically (1.67^s = average length of verses in the most rhythmical records, viz., E. W. S., H. Ö., O. S., A. R. P., J. K., I. M. and K. H. K.). This figure is considerably above MEUMANN'S, MARTIUS'S and TITCHENER'S results, and slightly below SMITH'S, for subjective accentuation; considerably above SCRIPTURE'S results for volitions, and below PACE'S, LANGE'S and TITCHENER'S results for the fluctuation of sensations. Hence the results of this experiment may apply only to verse intervals. This span should not be identified offhand with the spans (*a*) between the oscillations of attention for sensations, memory-images, illusions and simple voluntary efforts, and (*b*) between the accents in voluntary and involuntary subjective rhythmisation.

Results.—The verse interval rarely exceeds 5^s in length, nor does it fall much below 0.89^s (a range of a little over 4^s).

About 60 per cent. of the verse intervals that deviate most from the length of the average are extremes of excess. The balance are extremes of deficiency.

The average duration of a verse interval is about 2.69^s. It varies according to the character of the line and will lie for a given number of reciters, somewhere between approximately 2.05^s and 4.62^s, a range of 3.47^s.

In units of time the verse intervals of a given number of recited verses will vary from the length of the average by about 0.27^s.

The range of irregularity existing between a given number of recited verses of a given number of subjects may be approximately 0.46^s (from 0.09^s to 0.55^s).

As a fraction of the average, the irregularity of a given number of recited verses of a given number of subjects will be about 9%; and the range about 10% (from 5% to 15%).

The regularity is never precisely the same for different records of the same person. The difference will rise to about 5%.

Whenever the amount of irregularity exceeds 15 per cent. of the average duration, the mind finds it hard to rhythmise the series. The rhythm is obscure. Apparently when the percentage does not rise above 10%, the rhythm is fairly well preserved.

If we accept, provisionally, 10 per cent. of deviation as the limit of allowable inequality in good rhythm, 59 per cent. of the records of verse intervals are rhythmical and 41 per cent. are not.

The nature of the unity of the verse interval.—Assuming that a spoken line of poetry does not exceed the limits of the grasp of the rhythmic sense, and that it is rhythmically coordinated with other lines, it will stand forth as a unity in consciousness. Every verse is so far forth an absolute unity, whether its components are homogeneous or not, *i. e.*, made up entirely of sounds, or predominantly of sounds and partly of pauses. Psychologically a rhythmical line is a mental synthesis, regardless of its structure.

As a physical event, however, to constitute a unity the elements of speech must make an uninterrupted continuum. The unity of a verse is coterminous with homogeneity of process. The sounds constitute one order of homogeneity; the pauses, another. Whenever the two intermingle the spoken verse physically becomes heterogeneous, *i. e.*, non-unitary. Hence to be a physical, or physiological, unity, a verse must contain no sectional pauses. Such a verse unity, however, would, if



frequently repeated, become thread-bare and monotonous, although it would result in the best quality of rhythm.

Examples of verse intervals, that are physically homogeneous unities, may be seen by referring to the I. M., J. K., K. H. K., E. W. S. and H. Ö. records of V., B, above.

A physically homogeneous unity will coincide with a psychological unity when its limits are so coordinated as to coincide with the rhythmic beats of the latter.

The principles of the rhythmical coordination of verse intervals.—The principle according to which the records were differentiated as rhythmical and non-rhythmical, was that of time-coordination. The intervals formed a series of rhythmical intervals only provided the law of rhythm, as regards amount of inequality and length of span was observed. This principle, however, was found incapable of comprehending a complete explanation of the totality of the experience. To account fully for all cases of verse rhythm, it is necessary to invoke another principle,—that of emphasis. This is best exemplified in sing-song.

6. *Sing-song scansion.*—The table of measurements justifies the belief that the verses of the O. S. record (reading scansion) should give rise to the most distinct feeling of rhythmical unities. This is counter to the judgment of the ear, however, which found it easiest to grasp and retain in consciousness as rhythmical unities the first three verses, respectively, of the two stanzas of the H. Ö. record, and the last stanza of the E. W. S. record. These appeared completely unified sequences, not because the coordination impressed the ear as perfect, but because the principle of emphasis rendered the unity distinct in consciousness.

This unifying principle is more or less operative in all the records, but in the record of sing-song it follows a unique law, which may be expressed as an exact correspondence line for line, of certain centroids, as regards distribution and degree of intensity. When the major centroids are correlated vertically,—that is, placed on the numerically correspondent syllables of each line—the type of scansion differs from reading, doggerel and routine scansion, which at their best, merely attain a maximum regularity, in its strict observance of this law of emphasis. This species of scansion we may designate sing-song. It is this which produces the most vivid impression of verse unities. No verse rhythm can, psychologically considered, be compared with the sing-song.

To illustrate: in the E. W. S. record (last stanza), the beginning of every line received a specially strong accent upon the corresponding syllables. The accentuation was uniformly of the third degree, except in the last line. The stress of the last syllables of the verses, was uniformly sub-

ordinated to the stress of the first syllables. The intervening syllables, with one exception, were subordinate to those at the end. The predominant elements of the centroids were intensity for those at the close, and pitch and intensity for those at the beginning of the lines.

In the H. Ö. record the same general law is exhibited. The second degree centroid was placed, however, on the last syllable but one. This did not affect the sing-song swing. This record also differed in having a sectional pause between the two chief centroids. In both, however, the pauses at the end of the verses served to support the unity of the lines.

Conclusions.—These are suggested by the foregoing. Sing-song scansion is peculiar in being largely a matter of verse interval rhythm.

This peculiarity consists (a) in paying a strict regard to the temporal coordination of the intervals and (b) in observing a law of distribution and subordination of centroids. In respect to distribution, the law seems to require two strong centroids to the verse, placed on the corresponding syllables of each line, the one near the beginning, the other near the close. Hence in the distribution of the sing-song centroids, there is a balanced line arrangement.

In respect to subordination, there is a like correlated arrangement, line for line. But in each line, the centroids are unevenly balanced. It seems to open with a very strong explosion of the cords in which the element of pitch is prominent, is followed by a weak one and ends up with a fairly strong explosion in which the element of pitch is less prominent. For different speakers the distribution of the second and third degree centroids may be reversed.

It has been customary to explain the peculiarity of sing-song scansion as merely a phenomenon of exact rhythm.¹ To fully account for it as an occurrence in consciousness, however, a twofold principle needs be invoked.

Logical or reading scansion and doggerel and routine scansion observe no such principle, and the rhythm of the centroid intervals (cf. V., F., below) in reading scansion is almost invariably, and in doggerel scansion generally, less regular. Routine has the presumption of greater regularity than either doggerel or sing-song scansion, as may be seen by a comparison of the records.

Sing-song scansion might figuratively be called *pendulum-swing* scansion, where the height of the two swings differ somewhat, and routine or mechanical scansion, metronome scansion, where the strength or reach of the two swings is equal. In the latter kind, where the motive is merely to rigorously coordinate the distances between centroids, the function of

¹ ELLIS, *The Quantitative Pronunciation of Latin*, London 1874.

the sectional and terminal pauses becomes compensatory. They must be strictly limited.

Doggerel scansion is the most nearly like reading scansion, which is rhythmically free. The latter differs from the former in that it pays more heed to the logic or thought contained in the verses. When the logical and metrical accents coincide it tends to become doggerel. The two often coincide, as is instanced by the first six stanzas of the E. W. S., and the stanza of the A. R. P. records.

D. *Expiration (or sound) intervals.*

1. *Explanation.*—SWEET'S statement that the only divisions which are actually made in language are those into "breath groups," each group forming a closed system, in which, contrary to general opinion, there is no pause, as it stands, vague and unqualified, must be rejected. It does, however, express an important truth and may, with proper limitations, be accepted.

It is obvious that speech, as a physiological process, cannot continue indefinitely so as to form a perfect continuum. The vocal cords are incapacitated from functioning in an unbroken continuity, partly because such activity is antagonistic to the necessary process of alternate waste and repair, partly because the capacity of the air supply in the lungs is definitely limited for each individual, and partly because the specific function of speech, the expression of thought, could not be thus subserved. Hence the need of making divisions into sounds and pauses is inescapable.

In the sense, therefore, of a succession of physical or physiological processes in time, the only speech divisions are those into filled and vacant groups. These represent periods of expiration and inhalation. While physiologically they are indisputably the only divisions of speech, psychologically, other divisions obtain.

It is both true and false that within each expiration group no gaps occur. In the sense in which the word silence is used on p. 35 above, it is false. It has been shown that practically every sound is separated from every other by a gap, which, however, is generally so minute as to be imperceptible by the naked ear. The average duration is only 0.10° . Hence, if by pauses is not meant the necessary silences which intervene between separate sounds, but those gaps which, in the main purposeful, separate groups of words by silences other than those involved in the mere production of a series of sounds, it is true that the intervals in question constitute a closed system.

By expiration interval, then, is indicated a sequence of sounds limited by pauses. The following tables give the results of the measurement of

these intervals. The measurements extend through the entire length of the sequences. Only the lengths of the different sound intervals are given: not the sound intervals and pauses taken together. Every sound interval is invariably convertible into an expiration interval, since the outgoing of breath is the indispensable condition of producing vocal sounds. The pause intervals, contrariwise, are not invariably convertible into inhalation intervals. It requires less time to inhale a quantity of air than it takes to consume it in speaking. And oftentimes the quantity inhaled is so oppressive or excessive as to require exhaling during the pause interval, as is frequently seen in persons of a nervous disposition.

2. *Tables of measurements of expiration intervals.*

TABLE XIII.

(*Poetry.*)

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. W. R.	2.60	0.98	0.37	+ 4.77 — 0.48	+	27
E. W. S.	1.18	0.22	0.18	+ 2.31 — 0.41	+	35
A. D. B. _A	0.75	0.28	0.37	+ 1.73 — 0.14	+	15
A. D. B. _B	1.00	0.37	0.37	+ 2.16 — 0.25	+	8
W. W.	1.06	0.37	0.34	+ 2.62 — 0.18	+	38
A. R. P.	1.26	0.45	0.35	+ 1.90 — 0.12	—	5
J. K.	2.15	0.35	0.16		o	2
I. M.	2.39	0.33	0.13		o	2
K. H. K.	2.45	0.06	0.02	+ 2.54 — 2.31	—	4
H. Ö.	1.41	0.30	0.21	+ 2.02 — 0.65	—	11
O. S.	1.87	0.12	0.06	+ 2.12 — 1.53	—	7
E. H. T. _A	1.72	0.87	0.50	+ 3.45 — 0.54	+	4
E. H. T. _B	1.68	0.13	0.07	+ 2.00 — 1.56	+	4
Av.	1.65	0.37	0.24			.

TABLE XIV.

(*Prose.*)

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
G. A. A.	1.37	0.42	0.30	+ 3.00 — 0.32	+	21
W. L. P.	1.25	0.19	0.15	+ 1.90 — 0.12	+	20
C. O. S.	1.50	0.72	0.48	+ 3.42 — 0.15	+	21
Av.	1.37	0.44	0.31			

TABLE XV.
(Poetry read as prose.)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
C. O.	0.93	0.36	0.38	+ 1.60 — 0.12	—	17
W. C.	1.09	0.37	0.33	+ 2.50 — 0.70	+	12
S.	1.12	0.39	0.34	+ 2.10 — 0.32	+	12
Av.	1.04	0.37	0.35			

TABLE XVI.
(Poetry read as poetry.)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
C. O.	0.85	0.35	0.41	+ 1.85 — 0.12	+	17
W. C.	0.90	0.32	0.35	+ 1.85 — 0.27	+	15
S.	1.08	0.50	0.40	+ 3.00 — 0.25	+	15
Av.	0.94	0.39	0.40			

TABLE XVII.
(Poetry read as prose without punctuation marks.)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
G. F. A.	1.01	0.37	0.36	+ 2.00 — 0.22	+	16
B. S. G.	0.90	0.30	0.33	+ 2.07 — 0.25	+	16
Av.	0.95	0.33	0.34			

TABLE XVIII.
(Prose read as poetry.)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
S. I.	1.07	0.34	0.31	+ 2.25 — 0.60	+	9
O. E. S.	1.40	0.66	0.47	+ 3.46 — 0.27	+	9
Av.	1.23	0.50	0.39			

TABLE XIX.
(Table of summaries of expiration intervals of speech.)

Tables.	<i>a</i>	<i>p</i>	$\frac{p}{a}$
XIII.	1.65	0.37	0.24
XIV.	1.37	0.44	0.31
XV.	1.04	0.37	0.35

XVI.	0.94	0.39	0.40
XVII.	0.95	0.33	0.34
XVIII.	1.23	0.50	0.39
Av.	1.19	0.40	0.34

Unit of measurement, 1° ; a , average duration; p , immediate probable error; $\frac{p}{a}$, relative immediate probable error; e , extreme intervals; c , character of greater extreme.

3. *Observations.*—The study is based on 362 measurements.

Extreme intervals.—Of the 362 intervals the longest is 4.77° ; the shortest, 0.12° ; a range of 4.65° .

Character of greater extreme.—72 per cent. of the intervals which deviate the farthest from the average are extremes of excess, 19 per cent. of deficiency, and 8 per cent. are equal. The tendency in about three-fourths of the cases is to lengthen unduly, rather than shorten, the expiration intervals.

Average duration—(1) *For the series.* The average for the 362 intervals is 1.19° .

(2) *For the sets.* The longest average of any set of records is 1.65° . Table XIII., poetry; the shortest, 0.94° , Table XVI., poetry read as poetry. This gives a range of 0.71° .

The average of the set of prose records, Table XIV., is 1.37° . This is 0.28° less than for the corresponding set of records of poetry, Table XIII.

The set for poetry read as prose without punctuation marks, Table XVIII., affords the second shortest interval, 0.95° . It is 0.01° longer than for poetry read as poetry. The number of intervals is about the same in both tables.

The reading of the poetical passage as prose, Table XV., test records, resulted in lengthening the interval. The difference is 0.10° . This is in disagreement with the result noted above, that the expiration interval in reading poetry is longer than in reading prose. The discrepancy may be explained by the circumstance that the passage when read as prose was unfamiliar to the subject. This would entail a retarded utterance.

The intervals of the test records where prose was read as poetry, Table XVIII., are longer than in any of the other three test records.

(3) *For the records.*—The highest average duration of any single record is 2.60° , J. W. R., Table XIII., reading scansion; the lowest, 0.75° ; Table XIII., A. D. B., poetry; a range of 1.85° . The range for the records is 2.60 times larger than for the sets; and the range for the individual intervals is 2.51 times larger than for the records.

The greatest difference between the averages of two different records of the same subject is 0.19° ; the smallest, 0.04° ; a range of 0.15° .

Regularity—(1) *For the series.* The average inequality for the series of records is 0.40° . This is 34% of length of the average.

(2) *For the sets.* The highest degree of irregularity is 40%, Table XVI., poetry read as poetry; the lowest, 24%, Table XIII., different types of scansion of poetry; a range of 16%.

In units of time, the greatest irregularity is 0.50° (Table XVIII.) ; the lowest, 0.33° (Table XVII.) ; a range of 0.17° .

The irregularity was 5% smaller in the records where poetry was read as prose than in the records of the same passages read as poetry. The regularity for poetry read as prose without punctuation marks is greater than either; it is unexpectedly high.

The regularity for the records of scanned poetry is noticeably greater than for any other set.

(3) *For the records.*—The greatest absolute irregularity of any individual record, J. W. R., Table XIII., poetry, is 0.98° , or over one-third of the average length of the intervals; the lowest, ignoring the Persian record where the verse and expiration groups are coincident, is 0.12° , O. S., Table XIII., routine scansion; a range of 0.86° . This is five times the range existing between the sets of records.

The highest amount of relative irregularity is 50% ; the lowest 6% ; a range of 44%. This range is $2\frac{3}{4}$ times the range existing between the sets.

In the selections of the test read as prose and poetry, the amount of irregularity is higher, both absolutely and relatively, for the poetic rendering. This is at variance with Tables XIII. and XIV. A like discrepancy was noted above between the set of test records and those of prose and poetry. The discrepancy calls for explanation. May we assume the existence of a special talent for reading poetry, distinct from the ability to properly read prose? Some persons discourse eloquently on scientific themes, but make a botch of reciting poetry.

The greatest difference in the different records recited by the same person is 6% ; the smallest, 2% ; a range of 4%, which is exceedingly small.

4. *Results.*—The length of the expiration interval of ordinary speech may be presumed to lie somewhere within the limits of about 0.12° and 4.77° . In impassioned oratory the upper limit will evidently be overreached; the lower limit is relatively fixed (average unemphatic syllable = 0.11°).

About 72 per cent. of the expiration intervals of speech which deviate the farthest from the normal or average interval are extremes of excess; about 19 per cent., of deficiency; and about 8 per cent. are equal.

The length of the average expiration interval of speech will be approximately $1\frac{1}{5}$.

The difference in the length of the average expiration intervals of ordinary speech of different speakers is limited to about 1.85° .

As between the length of the average expiration interval of prose and poetry, the evidence suggests that the interval is slightly longer in the declamation of poetry. The explanation suggested is, (*a*) that the intervals in poetry tend to become unities coterminous with the verses (the average verse interval is about 2.26 times longer than the average expiration interval); and (*b*) that the more lyrical and impetuous emotions of poetic diction result in prolonging the intervals. The latter circumstance should obtain equally in impassioned prose.

The average length for the same person reciting the same lines on different occasions is not the same. The difference varies roughly from 0.04° (smallest difference) to 0.19° (largest difference).

The inequality in the length of successive expiration intervals will be equal to about one-third of the length of the average.

In units of time, the range in the inequality of the expiration intervals of different speakers will be about 0.86° (from 0.12° to 0.98°).

As a fraction of the average, the range of the inequality for different speakers will be about 44% (from 6% to 50%).

The regularity for the same person reciting the same passages on different occasions is not the same. It varies from something like 2% to 6%.

As between prose and poetry, the evidence suggests that the regularity is slightly higher for the latter.

The elimination of punctuation marks does not seem to increase the irregularity.

Accepting provisionally 10 per cent. as the criterion, the coordination of the lengths of expiration intervals of speech is rhythmical in 12 per cent. of the records.

5. *Interpretation of results.*—What is the psychological import of the above results? With what laws of mental procedure can, for example, the brevity of the expiration group be correlated? If we accept as true the doctrine of the periodic character of attention,¹ we find here a fitting illustration of its applicability to speech. Attention, subjectively considered, is detention in consciousness of sensations and other psychical phenomena that, through special fixation, have been exalted to a high degree of intensity, vividness and completeness. But this process of fixating the mind is of the nature of a wave or pulsation: it consists in an alternation of max-

¹ LADD, *Psychology, Descriptive and Explanatory*, 71 fl., New York 1896.

imal and minimal efforts. The period of these attentive efforts has been variously given (*cf.* VI., C, 3, above). The average sound group easily falls within the extremes. Manifestly, were the laws of attention disregarded in the expiration intervals of speech, the result would be a special strain upon the power of attention, resulting in a sacrifice of interest, in fatigue and diminished mental grasp. The laws of mental activity seem to demand that the words in speaking be grouped into short unities that agree, in the main, with the "unity of consciousness"; and that frequent, though brief, pauses be made to enable the mind to easily grasp and synthesize this manifold of sensation.

All this is important as affects the doctrine of conservation of psychical—not speaking now of physiological—energy. The mind conserves its energy by dividing its work into brief, but frequent and forceful, efforts, and by introducing brief and frequent, rather than long and infrequent, rests. This demand is unconsciously fulfilled in spoken language. The frequent pauses afford momentary opportunities for rest for both speaker and listener. Hence the possibility of listening attentively to a long discourse. A speaker who easily tires himself and his audience, and fails to rise to the full measure of his possibilities, will find here, it would seem, a suggestion.

It appears from our tables that the average duration of the intervals is less than our average wave of attention ($1\frac{3}{4}''$). This suggests an explanation of the phenomenon that the extremes of excess are vastly more numerous than the extremes of deficiency. On this supposition, we should expect to find, with an average that is rather in excess of the wave of attention, a greater number of minus extremes. The theory is suggestive, and is offered as an explanatory hypothesis that seems plausible and consistent with known laws of mental functioning.

The high degree of irregularity exhibited in the expiration intervals makes it evident that a supplementary principle is needed to complete the theory advanced above, namely the principle of change or variety. While the laws of mental behavior require the duration to be limited they do not require invariable uniformity of length within the limits. Such uniformity would result in intolerable monotony, and would be antagonistic of the essential rhythm of speech, the centroid rhythm. Hence the high degree of inequality displayed in the expiration intervals may conduce to restive and pleasing variety.

The numerical relation of syllables to the normal and maximal expiration intervals is shown in VI., 5, below.

E. Vacant intervals.

1. Explanation.—A vacant interval in speech is the sequence which intervenes between the adjacent termini of two consecutive expiration intervals. The interval is entirely void of sound. In contra distinction to the gaps which separate different components of a sound or expiration interval, these vacancies separate different sound intervals themselves. They may be called pauses, every variety of which occurring in uttered language is included in the term. In music the terms rest and stop are most frequently used.

The measurements extend from the end of the last or vanishing sound of the one interval, to the beginning of the first or appearing sound of the following interval. Only the length of successive pauses are compared. The rhythmic character of the alternation of vacant intervals and expiration intervals (roughly the rhythmic action of the lungs in speaking) can be obtained by taking both as unities of a series, finding the sum of the measurements of both, and the probable error, according to the formula on p. 39.

2. Measurements of vacant intervals.

TABLE XX.

(Poetry.)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. W. R.	0.63	0.19	0.30	+ 1.10 — 0.18	+	25
E. W. S.	0.43	0.11	0.25	+ 0.87 — 0.14	+	28
A. D. B. _A	0.48	0.23	0.47	+ 0.16 — 0.12	+	14
A. D. B. _B	0.52	0.19	0.36	+ 1.16 — 0.31	+	7
W. W.	0.57	0.15	0.26	+ 1.06 — 0.16	+	37
A. R. P.	0.46	0.17	0.36	+ 0.82 — 0.20	+	4
K. H. K.	0.54	0.06	0.11	+ 0.66 — 0.45	+	3
H. Ö.	0.46	0.13	0.28	+ 0.80 — 0.20	+	10
O. S.	0.44	0.09	0.20	+ 0.62 — 0.28	+	7
E. H. T. _A	0.21	0.01	0.04			3
E. H. T. _B	0.21	0.017	0.08	+ 0.25 — 0.18	+	3
Av.	0.45	0.12	0.24			

TABLE XXI.

(Prose.)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
G. A. A.	0.57	0.14	0.24	+ 1.17 — 0.15	+	20
C. O. S.	0.40	0.16	0.40	+ 0.97 — 0.17	+	19
W. L. P.	0.72	0.28	0.38	+ 1.45 — 0.20	+	10
Av.	0.56	0.19	0.34			

TABLE XXII.

(Poetry read as prose.)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. M. T.	0.39	0.12	0.30	+ 0.60 — 0.10	—	14
C. O.	0.43	0.13	0.30	+ 0.79 — 0.12	+	16
W. C.	0.71	0.28	0.39	+ 1.25 — 0.12	—	11
S.	0.67	0.22	0.32	+ 1.32 — 0.12	+	11
Av.	0.55	0.18	0.32			

TABLE XXIII.

(Poetry read as poetry.)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. M. T.	0.62	0.15	0.24	+ 0.91 — 0.16	—	14
C. O.	0.44	0.13	0.29	+ 0.73 — 0.18	+	16
W. C.	0.68	0.22	0.32	+ 1.20 — 0.22	+	12
S.	0.62	0.18	0.29	+ 1.12 — 0.17	+	14
Av.	0.59	0.17	0.28			

TABLE XXIV.

(Poetry read as prose without punctuation marks.)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. M. T.	0.35	0.10	0.28	+ 0.60 — 0.14	+	17
G. F. A.	0.47	0.15	0.31	+ 0.71 — 0.17	+	15
B. S. G.	0.44	0.15	0.34	+ 0.87 — 0.12	+	15
Av.	0.42	0.13	0.31			

TABLE XXV.
(*Prose read as poetry.*)

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>		<i>n</i>
S. I.	0.40	0.14	0.35	+0.72 —0.17	+	8
O. E. S.	0.43	0.09	0.20	+0.65 —0.25	+	8
Av.	0.41	0.11	0.27			

TABLE XXVI.
(*Summaries.*)

<i>Tables.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$
XX.	0.45	0.12	0.24
XXI.	0.56	0.19	0.34
XXII.	0.55	0.18	0.32
XXXIII.	0.59	0.17	0.28
XXIV.	0.42	0.13	0.31
XXV.	0.41	0.11	0.27
Av.	0.44	0.15	0.29

Unit of measurement, 1^s ; *a*, average duration; *p*, immediate probable error; $\frac{p}{a}$, relative immediate probable error; *e*, extreme intervals; *c*, character of greater extreme; *n*, number of intervals.

3. *Observations.*—The tables afford a study of 238 pauses.

Extreme intervals.—The W. L. P. record, colloquial prose, Table XXI., contains the longest individual interval, of the entire series, 1.45^s ; The J. M. T. record, Table XXII., poetry read as prose, the shortest, 0.10^s ; a span of 1.35^s .

The second longest is 1.32^s , poetry read as prose. Where poetry was read as prose without punctuation marks, the length of the longest interval does not exceed 0.87^s . Several intervals occupy 0.12^s .

Doubtlessly the longest extreme, especially in conversation, is frequently exceeded. These measurements do not include stops, such, for example, as are made in lecturing to students taking notes, in collecting one's wits, in deliberating, etc.

Character of greater extreme.—88 per cent. of the extremes are +, 12 per cent. —, and 0 per cent. 0. (The first are extremes the difference between which and the average is greater than the difference between the average and the shortest extreme; the second are extremes the difference between which and the average is greater than the difference between the average and the longest extremes; in the third case the extremes of excess and deficiency are equal.)

Average duration.—(1) *For the series.*—The average length of the 238 pauses, Table XXVI., is 0.44^s .

(2) *For the sets.*—The highest average is 0.59^s , Table XXIII., poetry read as poetry, which is followed by 0.56^s , Table XXI., prose; the lowest, 0.41^s , Table XXV., prose read as poetry; a range of 0.18^s . The average for the set read without punctuation marks is 0.42^s .

The average for the table of poetry is 0.11^s less than for the table of prose, whereas in Table XXIII., poetry read as poetry, it is 0.04^s greater than in Table XXII., poetry read as prose. An examination of the four tables suggests that the discrepancy might be due to the range in the character of the records of Tables XX. and XXI. The former contains the shortest average interval, in the record of routine scansion; the latter, the longest, in the record of colloquial prose. Eliminating these extremes, the averages will very nearly coincide.

The duration of the pauses in the set of records of the passage read without punctuation marks is 0.08^s shorter than for the pauses of the same passages reads as prose and poetry with the punctuation marks. The average number of pauses for the former set, however, is 15.6, for the latter, 13.5, a difference of 2.1. The highest number in any one record of the sets, 17, is contained in the Browning passage without the marks; the lowest number, 11, in the Tennyson passage read as prose with the marks. In the records of the same passage (Tennyson) without the marks the number is 15.

(3) *For the records.*—The highest average for any individual record is 0.72^s , W. P. L., Table XXI., prose, which is followed by 0.71^s , W. C., Table XXII., poetry read as prose, and 0.68^s , W. C., Table XXIII., poetry read as prose; the lowest is 0.21^s , E. H. T. A and B., Table XX., routine scansion, which is followed by 0.35^s , J. M. T., Table XXIV., poetry read as prose without punctuation marks; a range of 0.51^s . The range for the records is 2.73 times the range for the sets; and the range for the individual intervals is 2.64 times the range for the average intervals of the records. In the passages that were read by the same subject on two different occasions the highest difference is 0.23^s (J. M. T.); the lowest, 0.01^s (C. O.); a range of 0.22^s .

Absolute irregularity.—(1) *For the series.*—The irregularity in the co-ordination of the duration of the intervals of the series, Table XXVI., is 0.15^s .

(2) *For the sets.*—The highest amount is 0.19^s , Table XXI., prose; the lowest, 0.11^s ; Table XXV., prose read as poetry; a range of 0.08^s .

The average for Table XXIII., poetry read as poetry, is 0.01^s smaller than for Table XXII., the same passages read as prose. Table XXIV., where the punctuation marks were left out, is more regular than either.

The poetry records, Table XX., are 0.07^s more regular than the prose records, Table XXI.

(3) *For the records.*—The highest is 0.28^s , W. L. P., Table XXI., prose, and W. C., Table XXII., poetry read as prose; the lowest, 0.01^s , Table XX., E. H. T.A, routine scansion; a range of 0.27^s . This is approximately three and one-half times the range for the sets.

Relative irregularity.—(1) *For the series.* The average is 29%. Table XXVI.

(2) *For the sets.*—Table XXI., prose, contains the highest percentage of irregularity, 34%; Table XX., different types of scansion, the lowest, 24%; a range of 10%.

The inequality for the set where poetry was read as poetry, Table XXIII., is 4% smaller than for the sets where poetry was read as prose. The reading of the passages without the punctuation marks is 1% more regular than the former. The pauses in Table XX., poetry, are 10% more regular than in Table XXI., prose.

(3) *For the records.*—The largest amount of irregularity in any record is 47%, A. D. B., Table XX.; the smallest, 4%; making the extent of the range 43%. This is 4.30 times the range existing between the different sets of speech pauses.

The largest difference in the regularity of the pauses of the different records of the same person is 7%, W. C., the lowest, 1%, C. O.; a range of 6%.

The irregularity in the Tennyson stanzas of Tables XXII. and XIII., is greater than in the Browning stanza. In Table XXII. the difference is 5%, and in Table XXIII., 4%. This result appears anomalous. Metrically the verses of Tennyson are superior to the verses of Browning, both as regards the alternation of centroids and the scarcity of sectional pauses. The explanation, probably, is that the subjects W. C. and S. are more irregular in their pauses than J. M. T. and C. O.

4. *Results.*—The range of duration for the pauses of speech was approximately 1.35^s (from 0.10^s to 1.45^s). This should hold for ordinary pauses.

Of the greater extreme deviations of pauses from the length of the average pause, approximately 88% are extremes of excess, 12% extremes of deficiency, and 0% equal extremes.

The duration of an average pause in speech is approximately 0.44^s .

As between prose and poetry, the difference in the average duration is inconsiderable. This was *apriori* to be expected. The amount of rest required in both cases is the same. The pause is a physiological and psychological resting period.

The range in the duration of the average pauses of a given number of reciters will perhaps be about $\frac{1}{2}^s$ (from 0.21^s to 0.72^s).

The elimination of punctuation marks slightly increases the number, and decreases the average duration of pauses.

The duration of the average pause of the speech of the same person on different occasions is never exactly the same. It will vary ordinarily from about 0.01^s (smallest difference) to 0.23^s (largest difference).

The longest and shortest averages are found, apparently, in colloquial prose and routine scansion, respectively.

The average irregularity in the length of pauses in speech is equal to approximately 0.15^s , or about 30% of the average duration.

In respect to units of time, the amount of irregularity in the pauses of different speakers will vary within the limits of about 0.01^s and 0.28^s (a range of 0.27^s).

In respect to the length of the average, the irregularity of the pauses of a given number of persons will be limited to a range of about 43% (from 4% to 47%).

The coordination of the lengths of pauses is slightly more exact in poetry than in prose.

The elimination of punctuation marks, apparently, does not tend to increase the inequality of the coordination.

The regularity is most exact in routine scansion.

With a provisional criterion of 10 per cent. of permissible inequality, approximately 8 per cent. of the records of pauses of speech are rhythmically coordinated in length.

5. *Distribution of the pauses in poetry.—Explanation.*—A sectional pause is a vacant interval that occurs within a verse; a terminal pause, one that occurs at the end of a verse—that is, between two verses of poetry. The former is an intra-verse, the latter an inter-verse, pause.

The term sectional pause has been applied to the pauses of such poetry as contains intra-verse punctuation marks. A given verse may frequently contain one or more, or none of these. By some writers the term is limited to what is technically designated the “cæsura,” which is defined as a mid-verse pause occurring within a foot. In the sense in which the word is here employed it denotes any pause, given in the records, occurring within a verse.

The phrase “end-stopped line” is employed to denote a verse which is separated from the following verse by a punctuation mark. A “run-on line” is one that is not thus separated. In the run-on verses the punctuation mark is generally shifted to the first part of the following verse, where the pause should logically occur. The records present a variety of both kinds of verses.

The term terminal pause, in preference to the uncouth term end-line pause, will be employed to signify any pause that separates verses, whether run-on or end-stopped.

We shall tabulate the measurements under these two heads.

Measurements of—

(a) *Sectional pauses.*

TABLE XXVII.

(*Poetry.*)

Subject.	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i> ₁	<i>n</i> ₂
J. W. R.	3.40	0.48	0.16	0.33	7	7
E. W. S.	0.16	0.16			1	0
A. D. B.	4.37	0.33	0.10	0.30	13	4
W. W.	12.61	0.54	0.15	0.27	23	14
A. R. P.	0.20	0.20			1	0
H. Ö.	0.77	0.25	0.03	0.12	3	0
O. S.					0	2
Av.	3.58	0.32	0.11	0.25	6.8	3.8

TABLE XXVIII.

(*Poetry read as prose.*)

Subject.	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i> ₁	<i>n</i> ₂
J. M. T.	3.90	0.35	0.12	0.34	11	8
C. O.	4.85	0.37	0.11	0.29	13	8
W. C.	1.57	0.31	0.11	0.35	5	2
S.	1.92	0.38	0.11	0.28	5	2
Av.	3.06	0.35	0.11	0.31	8.5	5

TABLE XXIX.

(*Poetry read as poetry.*)

Subject.	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i> ₁	<i>n</i> ₂
J. M. T.	6.22	0.37	0.15	0.40	11	8
C. O.	5.16	0.39	0.12	0.30	13	8
W. C.	2.22	0.44	0.15	0.34	5	2
S.	3.80	0.47	0.13	0.27	8	2
Av.	4.35	0.41	0.13	0.32	9.2	5

TABLE XXX.

(*Prose read as poetry.*)

Subject.	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i> ₁	<i>n</i> ₂
S. I.	1.27	0.25	0.03	0.12	5	3
O. E. S.	1.81	0.36	0.05	0.13	5	3
Av.	1.54	0.30	0.04	0.12	5	3

TABLE XXXI.
(Poetry read as prose without punctuation marks.)

Subject.	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
J. M. T.	5.45	0.38	0.09	0.23	14
G. F. A.	6.15	0.47	0.15	0.31	13
B. S. G.	4.00	0.50	1.19	0.38	8
Av.	5.20	0.45	0.14	0.30	11.6

TABLE XXXII.
(Summaries of sectional pauses of poetry.)

Table.	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i> ₁	<i>n</i> ₂
XXVII.	3.58	0.32	0.11	0.25	6.8	3.8
XXVIII.	3.06	0.35	0.11	0.31	8.5	5.
XXIX.	4.35	0.41	0.13	0.32	9.2	5.
XXX.	1.54	0.30	0.04	0.12	5.	3.
Av.	3.13	0.34	0.09	0.25	7.37	4.2

Unit of measurement, 1". *d*, total duration; *a*, average duration; *p*, immediate probable error; $\frac{p}{a}$, relative immediate probable error; *n*₁, number of pauses; *n*₂, number of punctuation marks.

(b) Terminal pauses.

TABLE XXXIII.

(Poetry.)						
Subject.	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i> ₁	<i>n</i> ₂
J. W. R.	16.60	0.77	0.25	0.32	21	20
E. W. S.	12.00	0.44	0.11	0.25	27	22
A. D. B.	6.02	0.75	0.24	0.32	8	5
W. W.	8.64	0.61	0.13	0.21	14	13
H. Ö.	3.87	0.55	0.10	0.18	7	5
O. S.	2.93	0.42	0.09	0.21	7	5
A. R. P.	1.62	0.54	0.16	0.29	3	2
Av.	7.38	0.58	0.15	0.25	12.4	10.2

TABLE XXXIV.

(Poetry read as prose.)

Subject.	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i> ₁	<i>n</i> ₂
J. M. T.	1.62	0.54	0.06	0.11	3	3
C. O.	2.12	0.70	0.05	0.07	3	3
W. C.	6.37	1.06	0.10	0.09	6	6
S.	5.52	0.92	0.16	0.17	6	6
Av.	3.90	0.80	0.09	0.11	4.5	4.5

TABLE XXXV.

(Poetry read as poetry.)

<i>Subject.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i> ₁	<i>n</i> ₂
J. M. T.	2.31	0.77	0.05	0.06	3	3
C. O.	2.25	0.56	0.15	0.26	4	3
W. C.	6.02	0.86	0.20	0.23	7	6
S.	4.95	0.82	0.12	0.14	6	6
Av.	3.88	0.75	0.13	0.17	5	4.5

TABLE XXXVI.

(Prose read as poetry.)

<i>Subject.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i> ₁	<i>n</i> ₂
S. I.	1.95	0.65	0.07	0.10	3	3
O. E. S.	1.75	0.58	0.06	0.10	3	3
Av.	1.85	0.61	0.06	0.10	3	3

TABLE XXXVII.

(Poetry read as prose without punctuation marks.)

<i>Subject.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i> ₁	<i>n</i> ₂
J. M. T.	0.62	0.20	0.03	0.15	3	3
G. F. A.	1.02	0.51	0.24	0.47	2	3
B. S. G.	2.62	0.37	0.10	0.27	7	6
Av.	1.42	0.36	0.12	0.29	4	4

TABLE XXXVIII.

(Summaries of terminal pauses of poetry.)

<i>Table.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i> ₁	<i>n</i> ₂
XXXIII.	7.38	0.58	0.15	0.25	12.4	10.2
XXXIV.	3.90	0.80	0.09	0.11	4.5	4.5
XXXV.	3.88	0.75	0.13	0.17	5	4.5
XXXVI.	1.85	0.61	0.06	0.10	3	3
Av.	4.25	0.68	0.10	0.15	6.22	5.55

Unity of measurement, 1^s. *d*, total duration; *a*, average duration; *p*, immediate probable error; $\frac{p}{a}$, relative immediate probable error; *n*₁, number of pauses; *n*₂, number of punctuation marks.

Comparison of tables.—The study is based on 129 sectional pauses and 73 sectional punctuation marks; and on 122 terminal pauses and 114 terminal punctuation marks. This is exclusive of Tables XXXI. and XXXVII., poetry read as prose without punctuation marks.

Numerical relation of pauses to punctuation marks.—It is a trite obser-

vation, enforced by an examination of the records, that punctuation marks and pauses do not invariably coincide, and that pauses frequently occur irrespective of any visible symbol of punctuation. Furthermore, the tables warrant the assertion that the number of pauses, both sectional and terminal, exceeds the number of punctuation marks. That is to say, while, as the records show, the number of punctuation marks exceeds the number of correlative punctuation-mark pauses, the number of non-punctuation-mark pauses is so large that, for poetry in general, the pauses outnumber, quite considerably, the marks.

The proportion of the number of sectional pauses to sectional punctuation marks is as $5.37 : 4.2$; of terminal pauses to terminal punctuation marks, as $6.22 : 5.55$. In other words, the pauses occurring within the verses are 1.75 times more frequent than the corresponding punctuation marks; and those following, 1.12 times more frequent than the corresponding punctuation marks.

The highest number of sectional pauses occurring in any record is 23 , W. W., Table XXVII., where there are fourteen punctuation marks for eighteen verses of Byron's Childe Harold. In several records the sectional pause, as well as punctuation mark, is entirely lacking.

The proportion of the number of terminal punctuation marks to sectional punctuation marks is as $5.55 : 4.2$, or as $1.33 : 1$.

While the punctuation mark is thus, for a given variety of verses, generally largely of inter-verse occurrence, in certain kinds of verse structure it is exclusively a matter of inter-verse occurrence; yet in other cases the sectional punctuation marks are predominant. (As instances, see W. W. and C. O. records for the latter, and E. W. S., A. R. P. and H. Ö. records for the former).

The number of pauses occurring within the verse is proportioned to the number occurring at the end of the verse as $7.37 : 6.22$, or as $1.18 : 1$.

The proportion between the number of sectional and terminal pauses is thus smaller than the proportion between the number of sectional and terminal punctuation marks. Whereas the number of sectional punctuation marks is smaller than the number of terminal punctuation marks, the number of sectional pauses is greater than the number of terminal pauses. These facts may be interpreted as signifying that a certain artificiality obtains in the distribution of the punctuation marks in verse. The tendency is to unwarrantably eliminate the marks from the interior of the line. In reading, the deficiency of punctuation marks is restored by introducing extra sectional pauses. The tendency of the former should be to preserve the rhythm and obscure the thought, of the latter, to disturb the rhythm and elucidate the thought. Both principles find application in the records cited above.

The number of sectional pauses in Table XXVIII. is smaller than in the corresponding table (XXIX.), where the rendering was purposely poetical. This, possibly, explains why the latter does not sound more distinctly poetical than the former. Where the selections were read without punctuation marks, the number of sectional pauses, relatively to the number of punctuation marks in the corresponding records of Tables XXVIII. and XXIX., was increased. The number of terminal pauses, however, remains, relatively to the number of punctuation marks, the same as in the prose and poetry rendering of the same passage.

Relative total duration.—The average aggregate duration, Table XXXII., of the sectional pauses sustains the proportion to the terminal pauses (Table XXXVIII.) of $3.13^s : 4.25^s$, or as $1:1.35$. In respect of number of pauses the proportion is reversed—namely as $1.18:1$. That is, while the number of sectional pauses is approximately 20% higher than the number of terminal pauses, the duration of the sectional pauses is approximately 33% less than the duration of the terminal pauses. The difference in duration is thus larger than the difference in number.

The most notable exception is afforded by Tables XXXI. and XXVII., where the proportion of the duration of the sectional pauses to the terminal pauses is as $3.66:1$. The selection from Bryon, and the passages from Browning and Tennyson, also differ in this regard, the former (Browning) having the greater mass of silence within, the other (Tennyson) without, the verses. This suggests important considerations with reference to the metrical quality of the verses of the two types of poetry. The relatively greater number and aggregate duration of the sectional pauses tends to jeopardize the unity of the verse, and to cause to coalesce rather than segregate as distinct wholes, the successive verses. When the bulk of silence is thrown between, instead of within, the verses, they must needs stand forth in consciousness as unified groups of presentation complexes.

Relative average duration.—The duration of the average sectional pause is proportioned to that of the terminal as $0.34^s : 0.68^s$, or as $1:2$. In other words, the average terminal pause of a series of structurally different verses was precisely twice as long as the average sectional pause.

As has been suggested, this subordination of length of the sectional to the terminal pause, is probably the most potent principle of the segregation of verses into distinct groups.

The records in which the verse intervals most pronouncedly appear as distinct wholes are those in which the terminal pauses are predominant in the number of occurrences and in the quantity of duration (cf. E. W. S.,

O. S., A. R. P., H. Ö., and E. H. T. records). In the records in which this principle of subordination is violated, the unity of the verse interval is perceptibly disturbed (cf. W. W. record). When the principle of subordinating the sectional to the terminal pauses is reversed, the verse loses its character as a distinct unitary group. This is instanced in all the records where the punctuation marks were left out.

The observance of this principle largely gives the character of poetry to the passages that were read as prose. These passages with doubtful rhythm, sound more like poetry than prose. In fact, from this point of view, they are rather more poetical than the corresponding readings of the selections as poetry. Examination of the two series of records shows the following: the average sectional pause is 0.06° shorter in the table (XXVIII.) for poetry read as prose than in the table (XXIX.) for poetry read as poetry; the terminal pause, 0.05° longer. Naturally, we would expect the sectional pause to be shorter in the distinctly poetical renderings.

The observance of the rule of subordinating the length of the sectional to terminal pauses in the prose rendering of the set of test record, suggests that the structural (organic) and the logical pause arrangement in the verses coincide. Where the selection was printed as prose, no suggestions from the verse arrangement of the words could tend to make the terminal pauses longer. They were prolonged, evidently, because the subject felt that at those points in the sequence of words a long pause should naturally—because representing to the hearer a large stop or transition in the thought—be made. To preserve the integrity of the verse, the larger transitions in thought should be so arranged as to coincide with the terminal pauses. In the records of W. W. and J. M. T. this rule is not observed. The result is that the verses are split up and lose their unity, to retain which they would have to be scanned in such a fashion as to involve a sacrifice of thought. As between the two, the average reader prefers sacrificing rhythmical perfection to impairing the distinct articulation of the thought.

The introduction of the “cæsura” illustrates the same principle. The difference between the length of the cæsuras and the terminal pauses in the records is less than the difference between the other sectional pauses and the terminal pauses. The tendency of the cæsura is to split the verse up into two unities. The cæsural and the terminal punctuation marks should both coincide with naturally large thought transitions, to preserve the unity of the verse interval.

The subordination of pauses in verse finds its parallel in prose. The pauses between sentences are longer than those contained within sentences. The average for all kinds of pauses in prose (Table XXI.) is 0.56° . The

average for the pauses at the end of sentences is 1.21^s. (The records afford only seven instances.) The relation is as 1:2.16.

The difference between the two is, that the terminal pauses of poetry are relatively equidistant. In prose the sentence may be of a great variety of lengths; hence the terminal pause in prose is not nearly so periodically recurrent as in poetry. This constitutes the essential difference, which is so easily heard, between the pauses of prose and poetry.

All the records are in complete agreement with the principle of pause subordination, except two of the records of Table XXXI., prose without punctuation marks, where the average of the sectional pauses is 0.45^s. The pauses of these records, according to the judgment of the ear, are placed with hesitancy and diffidence.

Regularity.—The absolute regularity of the two series differs only by 0.01^s. The relative inequality of the terminal pauses is 15%; of the sectional 25%. The terminal pauses are one and two-thirds times as regular as the sectional.

The regularity is higher in the prose reading of the test than in the corresponding reading of the passages as poetry.

The lowest inequality for any set of records of sectional pauses is 12%, Table XXX., prose read as poetry, the highest, 32%, Table XXIX., poetry read as poetry; a range of 20%.

The lowest inequality for the terminal pauses is 10%, Table XXXVI., prose read as poetry; the highest 29%, Table XXXVII., poetry read as prose without punctuation marks; a range of 19%.

The lowest degree of irregularity for any record of sectional pauses is 12%, records of H. Ö. and S. I.; the highest, 40%, J. M. T.; a range of 28%.

For terminal pauses the lowest is 7%, C. O.; the largest 47%, G. F. A., the record without the punctuation marks; a range of 40%.

The range for the individual records of sectional pauses is 8% larger than the range for the sets; and, of the terminal pauses, 21% larger.

Results—

The number of pauses of all kinds in recited poetry is generally greater than the number of punctuation marks.

The number of punctuation-mark pauses is frequently if not generally slightly less than the number of punctuation marks, in recited poetry.

The proportion of the number of pauses to punctuation marks varies according as they are sectional or terminal. In respect to the sectional pauses, there were approximately 7 for every 4 punctuation marks; and for the terminal pauses, approximately 10 for every 9 punctuation marks.

The terminal punctuation marks for a varied collection of verses seem to be about $1\frac{1}{3}$ times the frequency of the sectional punctuation marks.

The frequency of sectional pauses, for a variety of verses, is approximately $1\frac{1}{5}$ times that of terminal pauses. Most punctuation marks, for a variety of verses, seem to be terminal; most pauses, sectional.

The combined length of the terminal pauses is approximately $1\frac{1}{3}$ times that of the sectional pauses. In some verses, however, the aggregate length of the latter may be approximately $3\frac{2}{3}$ times that of the former.

The average terminal pause in a variety of verses is about twice as long as the average sectional pause.

The subordination of sectional to terminal pauses helps largely to unify the verses into distinct wholes.

The terminal pauses of poetry occur, with a high degree of regularity, at relatively equidistant points; those of prose, at indefinite distances. The length of sentences in prose admits of nominal coordination; of verses in poetry, of a high degree of coordination. The latter may, and often do, become rhythmical; the former never or rarely do.

Removing punctuation marks reverses the rule of subordination: the terminal pauses become subordinate to the sectional. The latter are increased in both length and frequency when compared with records of the same selections with the marks; the former remain relatively the same. This reversal tends to destroy the unity of verse intervals.

The irregularity of the terminal pauses of poetry is about 15% of the average duration; of the sectional, 25%. The former are about $1\frac{2}{3}$ times more regular than the latter. This suggests that sectional pauses are a more important disturbing factor of the rhythm of verses than terminal.

The irregularity of the sectional pauses for different persons ranges from about 12% to 40% (28%); of the terminal pauses, from about 7% to 47% (40%) of the average.

Accepting 10% as the limit of inequality for rhythmical units, none of the records of sectional pauses, and only 25% of terminal pauses, are rhythmically coordinated in length.

6. The time value of punctuation marks.

Two divergent views have obtained: Complete lawlessness reigns among the different punctuation marks with respect to their relative time value; and, they may be arranged in a scale of values, whether or not the temporal and logical values correspond.

The tables are arranged in two groups: punctuation-mark pauses, and non-punctuation-mark pauses. The former correspond, in the records,

with the symbols which occur between the same words in print. These symbols were directly perceived, perhaps vaguely, as the selections were read; and were pictured perhaps, consciously or unconsciously, to the imagination, when the words were recited without looking at the printed page.

The term non-punctuation-mark pauses, however uncouth, indicates pauses in the records between the words of which there are no punctuation marks upon the printed page. These pauses are of two kinds: those purely accidental, and those conducive to emphasis. The latter may be emotional or logical. These add clearness and emphasis to the thought. This is not true of the fortuitous; they tend rather to obscure. In the table the division into logical and emotional is disregarded. A punctuation mark may frequently be inserted where they occur. The division into accidental and emphasis has been made by the judgment of the experimenter's ear, on the basis of the context or the mode of delivery. Terminal non-punctuation-mark pauses have generally been regarded as emphasis pauses.

Measurements of punctuation-mark pauses.

TABLE XXXIX.

<i>Subject.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
J. W. R.	1.79	0.89	0.03	0.03	2
E. W. S.	2.52	0.63	0.11	0.17	4
A. D. B.	2.33	1.16	0.00	0.00	2
A. R. P.	1.20	0.60	0.21	0.35	2
G. A. A.	0.57	0.57			1
W. L. P.	1.16	1.16			1
C. O. S.	2.27	0.75	0.12	0.16	3
W. C.	2.27	1.13	0.05	0.04	2
S.	1.80	0.90	0.16	0.17	3
S. I.	1.42	0.71	0.00	0.00	2
O. E. S.	1.28	0.64	0.00	0.00	2
W. C. _A	2.47	1.23	0.00	0.00	2
S. _A	1.77	0.88	0.08	0.09	2
Total	22.85	—	—	—	28
Av.		0.86	0.07	0.09	

TABLE XL.

(.)

<i>Subject.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
W. L. P.	1.45	1.45			1
G. A. A.	3.72	0.93	0.10	0.10	4
C. O. S.	0.90	0.90			1
O. S.	0.62	0.62			1
H. Ö.	0.82	0.82			1
C. O.	0.62	0.62			1
J. M. T.	0.87	0.87			1
C. O. _A	0.64	0.64			1
Total	9.64	—	—	—	II
Av.		0.85	0.10	0.10	

TABLE XLI.

(, -)

<i>Subject.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
W. W.	1.66	0.83	0.00	0.00	2
W. L. P.	1.12	1.12			1
J. M. T.	1.45	0.72	0.03	0.04	2
C. O.	1.06	0.53	0.00	0.00	2
Total	5.29	—	—	—	—
Av.		0.80			7

TABLE XLII.

(!)

<i>Subject.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
J. W. R.	1.10	1.10			1
W. W.	5.37	0.76	0.05	0.06	7
W. L. P.	1.87	0.93	0.58	0.62	2
J. M. T.	1.64	0.54	0.19	0.35	3
C. O. _B	2.02	0.67	0.03	0.04	3
C. O. _A	1.85	0.61	0.14	0.22	3
Total	13.85	—	—	—	19
Av.		0.77	0.19	0.26	

TABLE XLIII.

(,)

<i>Subject.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
J. W. R.	10.29	0.68	0.19	0.28	15
E. W. S.	5.43	0.49	0.02	0.04	11
A. D. B.	4.64	0.66	0.16	0.24	7
W. W.	7.56	0.47	0.12	0.25	16
H. Ö.	1.47	0.49	0.05	0.10	3
O. S.	1.81	0.45	0.09	0.20	4
G. A. A.	6.20	0.48	0.09	0.18	13
W. L. P.	3.77	0.75	0.21	0.28	5
C. O. S.	1.70	0.42	0.13	0.30	4
J. M. T.	2.06	0.68	0.06	0.08	3
C. O.	1.12	0.28	0.07	0.25	4
W. C.	4.75	0.79	0.13	0.16	6
S.	4.50	0.75	0.13	0.17	6
S. I.	0.87	0.29	0.03	0.10	3
O. E. S.	1.12	0.39	0.02	0.05	3
C. O. _A	2.70	0.45	0.09	0.20	6
W. C. _A	4.67	0.77	0.21	0.27	6
S. _A	4.77	0.79	0.21	0.26	6
Total	69.43				
Av.		0.56	0.11	0.18	121

TABLE XLIV.

(—)

<i>Subject.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
E. W. S.	1.75	0.43	0.09	0.20	4
J. M. T.	0.57	0.57			1
S. I.	0.52	0.52			1
O. E. S.	0.46	0.46			1
C. O.	0.66	0.66	—	—	1
Total	3.96				8
Av.		0.53	0.09	0.20	

TABLE XLV.

(:)

<i>Subject.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
E. W. S.	0.60	0.30	0.06	0.20	2
C. O. S.	0.57	0.28	0.15	0.53	2
H. Ö.	0.37	0.37			1
W. L. P.	1.10	1.10			1
C. O. _B	0.45	0.45			1
J. M. T.	0.62	0.62			1
C. O.	0.56	0.56	—	—	1
Total	4.27				9
Av.		0.52	0.10	0.36	

TABLE XLVI.
(Summaries for punctuation-mark pauses)

Table.	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
XXXIX. (;)	22.85	0.86	0.07	0.09	27
XL. (.)	9.64	0.85	0.10	0.10	11
XLI. (, -)	5.29	0.80			7
XLII. (!)	13.85	0.77	0.19	0.26	19
XLIII. (,)	69.43	0.56	0.11	0.18	121
XLIV. (—)	3.96	0.53	0.09	0.20	8
XLV. (:)	4.27	0.52	0.10	0.36	9
Total	129.29				202
Av.		0.70	0.11	0.19	

Unit of measurement, i^s . p , immediate probable error.*d*, duration. $\frac{p}{a}$, relative immediate probable error.*a*, average duration.*n*, number of punctuation marks.

Measurements of non-punctuation-mark pauses.

TABLE XLVII.

(Emphasis)

Subject.	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
J. W. R.	2.14	0.42	0.15	0.35	5
E. W. S.	1.11	0.27	0.07	0.25	4
A. D. B.	2.45	0.27	0.10	0.37	9
W. W.	4.07	0.50	0.17	0.34	8
A. R. P.	0.42	0.42			1
O. S.	0.34	0.34			1
H. Ö.	1.95	0.39	0.13	0.33	5
W. L. P.	2.68	0.44	0.15	0.34	6
G. A. A.	0.87	0.43	0.03	0.07	2
C. O. S.	2.02	0.25	0.04	0.16	8
J. M. T.	0.58	0.29	0.11	0.37	2
C. O.	0.95	0.23	0.05	0.21	4
W. C.	0.90	0.30	0.05	0.16	3
S.	1.42	0.47	0.16	0.34	3
S. I.	0.60	0.30	0.02	0.06	2
O. E. S.	0.43	0.43			1
Total	22.93				64
Av.		0.36	0.09	0.25	

TABLE XLVIII.

(Accidental)

<i>Subject.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
J. W. R.	0.47	0.23	0.06	0.26	2
E. W. S.	0.31	0.15	0.00	0.00	2
A. D. B.	0.93	0.31	0.04	0.12	3
W. W.	0.95	0.47	0.00	0.00	2
A. R. P.	0.20	0.20			1
O. S.	0.31	0.31			1
W. L. P.	0.54	0.27	0.00	0.00	2
C. O. S.	0.27	0.27			1
J. M. T.	0.91	0.91			1
C. O.	1.00	0.50	0.14	0.28	2
W. C.	0.32	0.32			1
S.	1.02	0.34	0.15	0.44	3
O. E. S.	0.25	0.25			1
Total	7.48	—	—	—	22
Av.		0.34	0.05	0.15	

TABLE XLIX.

(Summaries of non-punctuation-mark pauses)

<i>Table.</i>	<i>d</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
XLVII. (Emphasis)	22.93	0.36	0.09	0.25	64
XLVIII. (Accidental)	7.48	0.34	0.05	0.15	22
Total	30.41	—	—	—	86
Av.		0.35	0.07	0.20	

Unit of measurement, *sec.**d*, total duration.*a*, average duration.*p*, immediate probable error. $\frac{p}{a}$, relative immediate probable error.*n*, number of pauses.

Results.—Two hundred and eighty-eight pauses were measured, 202 punctuation-mark and 86 non-punctuation-mark. Unfortunately several of the punctuation-marks occurred so infrequently as to render some of the results entirely provisional. Far more measurements are needed.

In respect to the frequency of pauses occurring in speech, approximately 75 per cent. are punctuation-mark pauses. The balance are non-punctuation-mark pauses. In the records, 60% of the former, were commas, 13% semicolons, 9% exclamation-marks, 5% periods, 4% colons, 3% dashes and 3% comma-dashes (,-). The records of poetry, although more numerous than those of prose, contain: of semicolons

66%, periods 45%, comma-dashes 86%, exclamation-marks 87%, commas 72%, colons 62%, and dashes 75%. This may possibly indicate that the periods are more abundant in prose, and the exclamation-marks and comma-dashes in poetry.

About 75% of the non-punctuation-mark pauses are emphasis pauses. These tend to contribute strength and perspicuity to, and the accidental pauses to detract these from, the thought of the sentences. The accidental pauses, as was to be expected in rational, coherent speech, are very rare (about 7% of all pauses).

Apparently, over 40% of the pauses of speech are comma pauses. The relative frequency of the different punctuation marks differs somewhat for poetry and prose, and for different styles of writing.

The punctuation-mark pauses in the records occupy about 80% of the aggregate duration of all kinds of pauses. Of the former, commas occupy 53%; semicolons, 17%; exclamation-marks, 10%; periods, 7%; comma-dashes, 4%; colons, 3%; and dashes 3%. The time subordination corresponds with that of frequency, but the percentages do not exactly correspond.

The time value of the average punctuation-mark pause is about twice that of the non-punctuation-mark pause (former in records = 0.70^s; latter = 0.35^s).

The shortest average punctuation-mark pause (:) is seemingly longer than the longest average non-punctuation-mark pause. The difference was about 0.16^s. Only nine of the former were measured. It may be somewhat uncertain.

The longest average punctuation-mark pause is considerably longer than the shortest average punctuation-mark pause [about 0.34^s; from 0.52^s (:) to 0.86^s (;)].

The average accidental and emphasis pauses appear to be about equal in length (range, 0.02^s).

The duration of an average punctuation-mark pause of spoken poetry and prose is about 0.70^s.

Punctuation marks differ in respect to the time which they occupy in speech, both absolutely and relatively. Generally, no two consecutive punctuation marks, of the same or different kind, are exactly coordinated in length. The longest and shortest averages of the tables are as follows: semicolons, 1.23^s, and 0.57^s (range, 0.66^s); periods (Table XL.), 1.45^s and 0.62^s (range, 0.83^s); comma-dashes (Table XLI.), 1.12^s and 0.53^s (range, 0.59^s); exclamation-marks (Table XLII.), 1.10^s and 0.54^s (range, 0.56^s); commas (Table XLIII.), 0.79^s and 0.28^s (range, 0.51^s); dashes (Table XLIV.), 0.66^s and 0.43^s (range, 0.23^s); and colon pauses

1.10^s and 0.37^s (range, 0.73^s). The range for the three punctuation-mark pauses of greatest frequency follows the subsumption according to the average duration: it is greatest for the semicolon, and least for the comma, pauses. The difference in the ranges of these is 0.15^s .

The average lengths of different punctuation marks obey a rule of subordination, more or less indefinite in details. In the main, we can arrange them in three groups: (1) the semicolon and period; (2) the exclamation-point and comma-dash; and (3) the comma, dash and colon. The interrogation point presumably belongs to one of the first two. The approximate value of the first group is 0.86^s , of the second, 0.78^s , and the third, 0.53^s . No fixed line of demarkation exists between the groups. The difference between (1) and (2) (it is possible to combine them into one) appears less marked than between (2) and (3).

The regularity of punctuation and non-punctuation-mark pauses is about equal. The average amount of irregularity is approximately 0.10^s , or 19% of the average duration.

Apparently, commas are more irregular than semicolons. Exclamation-marks are doubtful, owing to extreme irregularity of W. L. P. The frequency of the other punctuation-marks is insufficient to justify any conclusions.

The range of irregularity for the punctuation-mark pauses of a given number of speakers is, in units of time, about 0.19^s (from 0.02^s to 0.21^s); and, as a fraction of the average, about 50% (from 3% to 53%). This is slightly larger than for non-punctuation mark pauses (0.15^s , or 38%).

Accepting tentatively the 10% criterion, 43% of the semicolons, 40% of the exclamation-marks, 28% of the commas, 15% of the emphasis pauses and 0% of the accidental pauses, are rhythmically coordinated in length. The figures for the comma and emphasis pauses are the most trustworthy.

The concept of the punctuation mark.—Upon the printed page it is a symbol, like any other character of type, meaningless apart from an interpreting mind. Through experience, it acquires a definite connotation just like any of the letters.

Every character upon the page has a twofold significance for speech: it represents a physiological and a psychological process. The latter is conditioned upon a presentation of sense; and is translated into a definite motor innervation as soon as it is apperceived. When the characters are letters, in isolation or in combination, the apperception of a letter or word expresses itself in a definite adjustment of the larynx, giving rise to a definite sound.

Similarly, punctuation marks are meaningless presentations until

apperceived. They acquire a definite meaning according to the way the contours differ. The significance of any cognate characters depends upon such distinguishing traits of contour. A . and a ;, just as an s and a c, are connected with distinct apperceptions.

As interpreted presentations (apperceptions), punctuation marks denote breaks or transitions in the continuity of the thought and differences in the quality or character of the pause. A period denotes the termination of a single wave (pulse or oscillation) of thought; a semicolon, a ripple in the wave without being a break; and the comma, a minor ripple. The two latter are a species of subordinate waves comprehended in the unity of the whole wave. There are several such species of thought-waves, *e. g.*, those of declaration, interrogation, exclamation. In the main, the different punctuation marks have as fixed a signification for thought as do the letters of the alphabet.

Finally, as motor resultants they denote physiological processes differing according as the marks and the character of the waves of thought differ. The physiological differences are threefold: (1) *As to modulation.* The pitch of the voice varies according to the character of the sign. This is a subject for special research. (2) *As to timbre.* This is specially noticeable in the bracket and parenthesis (or in the parenthetical commas), question-mark and exclamation-mark. This subject also merits special investigation. (3) *As to the pause.* This is perhaps the most obvious difference. Punctuation marks, physiologically considered, are pauses, the average length of which varies for the different marks, as has been shown above.

It is largely upon the basis of these three characteristics, that a listener can punctuate the speech of a lecturer, who is observing in his speech, evidently unconsciously, the laws of the physiology of the punctuation mark.

Hence a given punctuation mark is on the one hand a visible symbol, directly perceived by the eye, or represented to the imagination—however vaguely—which signifies to the reader a turn or break in the movement of thought; and, on the other, an auditory image which, as a moment in the physiological process of speech, is distinguished by changes in duration of pause, in pitch and quality of sound. In these respects it is a mental item, representing quantitative and qualitative peculiarities.

F. Centroid intervals.

By a centroid interval is understood the interim, spatial upon the page to the eye, temporal in speech to the ear, which stretches between two successive centroids, i.e., from centroid *a*, to centroid *b*, from cen-

troid b to centroid c , and so on. Hence every centroid interval includes one centroid.

According to BRÜCKE the centroid interval lies between two "Arsengipfeln"; according to MINOR, it begins with the syllable standing in arsis; and according to MEYER,¹ when the beginning of the arsis coincides with the beginning of a syllable, and the end of the thesis with the end of a syllable, the limits of the foot and syllable coincide. MEUMANN² and BOLTON³ find experimentally that accented sounds occupy the first place in the interval. Our measurements extend as nearly as possible between two successive centroids.

In music the centroid interval is popularly designated a bar; in poetry, a foot or a measure; and in prose it has no distinctive name.

The centroids of speech and music are, as centroids, one and the same. The intervals between them are also as intervals, identical. All centroids can be subsumed under the laws of centroid composition; all the intervals, under those of centroid-interval composition.

Hence the term centroid interval is applicable to all sorts of human utterance—poetry, prose and music. No justification exists for drawing hard and fast lines between either the centroids or centroid intervals of these, although slight differences may, and do, obtain between the regularity of the intervals and the relation of the elements in the centroids of poetry, prose and music.

The composition of centroid intervals.—Only two kinds of materials can enter into their composition—sounds and silences, or syllables and pauses. A centroid interval may be composed purely of a sound-plenum, though not of a pause-plenum. It must always contain a certain quantum of sound.

Centroid intervals consisting of sounds, or syllables, only may be called *sound-centroid intervals*; those of sounds and silences, or syllables and pauses, *composite-centroid intervals*.

Sound-centroid intervals may be divided into the following varieties: (1) 1-syllable intervals. Here the centroid syllables are directly contiguous; no unemphatic syllable or pause intervenes between them. Hence the interval consists simply of one centroidal syllable. The existence of such intervals has been both denied⁴ and affirmed.⁵ The

¹ MEYER, *Beiträge zur deutschen Metrik*, Neuere Sprachen, 1898 VI 136–138.

² MEUMANN, *Untersuchungen zur Psychologie und Ästhetik des Rhythmus*, Philos. Stud., 1894 X 303.

³ BOLTON, *Rhythm*, Am. Jour. Psych., 1893 VI 222.

⁴ ABBOTT AND SEELEY, *English Lessons for English People*, 154, Boston 1880.

⁵ MAYOR, *Chapters on English Metre*, III, London 1886.

records furnish numerous instances of this type. (2) *2-syllable*, containing an intervening syllable, or one centroidal and one non-centroidal syllable. (3) *3-syllable*, composed of one centroidal and two non-centroidal syllables. (4) *4-syllable*, consisting of one centroidal and three non-centroidal syllables. (5) *5-syllable* centroid intervals, consisting of one centroidal and four non-centroidal syllables. These are exceedingly rare; the number in the records is too small for purposes of study. GURNEY¹ holds that no centroid interval can be composed of more than one centroidal and four non-centroidal syllables; and MAYOR,² that even three consecutive syllables without a metrical accent is impossible.

The *composite-centroid* intervals may be divided as follows: (1) *1-pause-1-syllable* intervals, consisting of one pause in addition to the centroidal syllable. (2) *1-pause-2-syllable*, consisting of one pause, one centroidal and one non-centroidal syllable, the pause preceding or following the unemphatic syllable. (3) *1-pause-3-syllable*, composed of one pause, one centroidal and two non-centroidal syllables. (4) *1-pause-4-syllable*, composed of one pause, one centroidal and three non-centroidal syllables. (5) *1-pause-5-syllable*, containing one pause, one centroidal and four non-centroidal syllables.

The records furnish instances, too scant for purposes of study, of other modes of composition, such as *2-pause-2-syllable*, and *2-pause-1-syllable* centroid intervals.

The lengths of each variety of the two groups of centroid intervals were measured.

Results.—The study is based on 69 1-syllable, 238 2-syllable, 47 3-syllable and 12 4-syllable intervals.

The average duration of the sound-centroid intervals of speech is about 0.51^s. This is about the same as Martius' period for subjective rhythmisation (0.50^s). The average for the 1-syllable intervals was 0.32^s; for the 2-syllable, 0.44^s; for the 3-syllable, 0.62^s; for the 4-syllable, 0.69^s.

Any 1-syllable interval occurring in speech may be presumed to fall within the limits of about 0.14^s and 0.56^s (range, 0.42^s); any 2-syllable, within 0.18^s and 0.79^s (range, 0.61^s); and any 3-syllable, within 0.37^s and 0.97^s (range, 0.60^s). (For the 4-syllable interval the measurements are insufficient). Any one of the different varieties may be presumed to fall within 0.14^s and 0.97^s (range, 0.83^s).

The range for the averages of different records is about as follows: For 1-syllable intervals, 0.18^s (from 0.25^s to 0.43^s); for 2-syllable, 0.17^s (from 0.36^s to 0.53^s); for 3-syllable, 0.40^s (from 0.49^s to 0.89^s); and

¹ GURNEY, *The Power of Sound*, 433, London 1880.

² MAYOR, *Chapters on English Metre*, III, London 1886.

Measurements of sound-centroid intervals.

TABLE L.
1-syllable sound-centroid intervals.

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. M. T.	0.28	0.05	0.17	+ 0.45 — 0.14	+	14
C. O. B.	0.25	0.05	0.20	+ 0.43 — 0.16	+	14
W. W.	0.31	0.05	0.16	+ 0.47 — 0.18	+	17
E. W. S.	0.40	0.03	0.07		o	2
A. D. B. A.	0.27					2
G. A. A.	0.30	0.05	0.18	+ 0.47 — 0.22	+	5
W. L. P.	0.29	0.07	0.24	+ 0.41 — 0.22	+	3
C. O. S.	0.36	0.08	0.22	+ 0.50 — 0.20	—	5
S. I.	0.38	0.05	0.13	+ 0.47 — 0.32	+	3
O. E. S.	0.43	0.05	0.11	+ 0.56 — 0.34	+	4
Av.	0.32	0.05	0.16		—	—

TABLE LI.
2-syllable sound-centroid intervals.

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. M. T.	0.46	0.08	0.17	+ 0.75 — 0.25	+	17
C. O.	0.36	0.06	0.16	+ 0.54 — 0.18	o	14
S. I.	0.43	0.04	0.09	+ 0.52 — 0.35	+	6
O. E. S.	0.48	0.09	0.18	+ 0.65 — 0.21	—	8
W. W.	0.42	0.07	0.16	+ 0.66 — 0.20	+	42
A. D. B. A.	0.53	0.10	0.18	+ 0.79 — 0.31	+	6
E. W. S.	0.44					60
G. A. A.	0.41					33
W. L. P.	0.41					26
C. O. S.	0.52					26
Av.	0.44	0.07	0.15			

TABLE LII.

3-syllable sound-centroid intervals.

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
W. W.	0.72	0.08	0.11	+ 0.97 — 0.58	+	5
E. W. S.	0.49	0.04	0.08	+ 0.56 — 0.37	—	12
A. D. B. ₄	0.56	0.14	0.25	+ 0.79 — 0.37	+	3
G. A. A.	0.51	0.05	0.09	+ 0.62 — 0.37	—	10
W. L. P.	0.60	0.08	0.13	+ 0.70 — 0.41	—	4
C. O. S.	0.63	0.08	0.12	+ 0.75 — 0.37	—	8
S. I.	0.61	0.06	0.09	+ 0.70 — 0.50	—	3
O. E. S.	0.89					2
Av.	0.62	0.07	0.12			—

TABLE LIII.

4-syllable sound-centroid intervals.

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. M. T.	0.72					I
C. O.	0.60					I
G. A. A.	0.65	0.02	0.03	+ 0.70 — 0.62	+	3
W. L. P.	0.68	0.08	0.11	+ 0.77 — 0.54	—	3
C. O. S.	0.83					2
S. I.	0.62					I
O. E. S.	0.78					I
Av.	0.69	0.05	0.07			—

Unit of measurement, 1^s.*a*, average duration.*p*, immediate probable error. $\frac{p}{a}$, relative immediate probable error.*e*, extreme intervals.*c*, character of greater extreme.*n*, number of intervals.

Measurements of composite-centroid intervals.

TABLE LIV.

1-pause-1-syllable composite-centroid intervals.

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
E. W. S.	0.74	0.11	0.14	+ 1.12 — 0.52	+	11
A. D. B. _A	0.66					1
W. W.	0.98	0.14	0.14	+ 1.47 — 0.72	+	11
J. M. T. _C	0.92	0.08	0.08	+ 1.04 — 0.77	—	5
C. O. _B	0.64	0.16	0.25	+ 1.02 — 0.43	+	6
W. L. P.	1.34	0.19	0.14	+ 1.75 — 1.00	+	5
C. O. S.	0.75	0.32	0.42			2
S. I.	0.47					1
O. E. S.	0.65					1
Av.	<u>0.68</u>	<u>0.16</u>	<u>0.19</u>	—	—	—

TABLE LV.

1-pause-2-syllable composite-centroid intervals.

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
E. W. S.	0.71	0.08	0.11	+ 0.89 — 0.50	—	13
A. D. B.	1.07	0.28	0.26	+ 1.68 — 0.70	+	7
W. W.	0.91	0.17	0.18	+ 1.66 — 0.56	+	25
J. M. T. _C	0.79	0.15	0.19	+ 1.04 — 0.47	—	7
C. O. _B	0.75	0.13	0.17	+ 1.06 — 0.43	—	10
G. A. A.	0.95	0.17	0.17	+ 1.47 — 0.62	+	14
W. L. P.	1.26	0.20	0.15	+ 1.66 — 0.68	+	7
C. O. S.	0.78	0.21	0.26	+ 1.45 — 0.47	+	11
S. I.	0.82					2
O. E. S.	0.90					3
Av.	<u>0.89</u>	<u>0.17</u>	<u>0.18</u>	—	—	—

TABLE LVII.

1-pause-3-syllable composite-centroid intervals.

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
E. W. S.	0.75					2
A. D. B. _A	0.82	0.25	0.30	+ 1.35 — 0.45	+	4
W. W.	1.31					1
G. A. A.	0.86	0.34	0.39	+ 1.47 — 0.50	+	3
W. L. P.	0.90	0.15	0.16	+ 1.29 — 0.70	+	5
C. O. S.	0.92	0.14	0.15	+ 1.25 — 0.77	+	4
S. I.	0.75					1
Av.	0.91	0.22	0.25			—

TABLE LVIII.

1-pause-4-syllable composite-centroid intervals.

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
G. A. A.	1.05	0.15	0.14	+ 1.30 — 0.85	+	3
W. L. P.	1.93					1
S. I.	0.95	0.21	0.22		0	2
O. E. S.	1.04	0.13	0.12		0	2
Av.	1.24	0.16	0.16			—

TABLE LVIII.

1-pause-5-syllable composite-centroid intervals.

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>n</i>
S. I.	1.02	0.21	0.20	2
O. E. S.	1.26	0.07	0.05	2
Av.	1.14	0.14	0.12	—

*Unit of measurement, 1^s.**e*, extreme intervals.*a*, average duration.*c*, character of greater extreme.*p*, immediate probable error.*n*, number of intervals. $\frac{p}{a}$, relative immediate probable error.

for 4-syllable intervals, 0.23^s (from 0.60^s to 0.83^s). The range appears to be highest for the average 3-syllable intervals.

The length of the average sound-centroid interval is invariably proportioned to the number of syllables of which it is composed. This is true alike of the reading scansion of poetry and prose. Single intervals frequently depart from this rule.

The addition of a syllable to sound-centroid intervals increases their average duration about 30%. The addition to the 3-syllable interval appears to result in the smallest, and to the 2-syllable, in the largest increment. (Average 2-syllable, 37% longer than 1-syllable; 3-syllable, 40% longer than 2-syllable; 4-syllable, 11% longer than 3-syllable.)

The difference between the lengths of the different intervals appears to be very slightly larger in poetry than in prose.

No sound-centroid intervals are of precisely the same length. The average inequality of the four kinds is about 0.06^s , or a trifle over 12% of the duration. Apparently it is very slightly smaller for the longer than the shorter intervals.

The extreme deviations of the 1-syllable ($75\% = +$, $11\% = -$, $11\% = 0$) and 2-syllable ($66\% = +$, $16\% = -$, $16\% = 0$) intervals are predominantly extremes of excess. For the others (for 3-syllable, $28\% = +$, $71\% = -$) the predominant extremes are liable to be those of deficiency. Of all the varieties, 58% were extremes of excess, 33% of deficiency, and 9% were equal.

The 2-syllable interval is the predominant sound-centroid interval of speech. This is true alike of prose and dactylic and trochaic verse. (For poetry and prose, $65\% = 2$ -syllable; 18% , 1 syllable; 13% , 3-syllable; 3% , 4-syllable). The 5-syllable and 4-syllable are the most infrequent. They seem to be less frequent in poetry than in prose.

According to the criterion of 10% of irregularity, 11% of the 1-syllable, 16% of the 2-syllable and 43% of the 3-syllable sound-centroid intervals were rhythmically coordinated in length. The large percentage for the 3-syllable may indicate that centroid intervals of about 0.65^s are most easily rhythmized. For all varieties of sound-centroid intervals the figure is about 25%.

The study of the composite intervals is based on the measurement of 43 1-pause-1-syllable, 99 1-pause-2-syllable, 20 1-pause-3-syllable, 8 1-pause-4-syllable and 4 1-pause-5-syllable intervals.

The average duration of the five varieties of these intervals in speech was about 0.97^s .

It seems to be larger in proportion to the number of syllables of which the interval is composed. This rule meets with many variations in the individual records.

The difference between the averages of all the 1-pause-1-syllable and the 1-pause-2-syllable intervals was 0.21^s; between the latter and the 1-pause-3-syllable, 0.02^s.

Any single one of the five varieties occurring in ordinary speech may be presumed to fall within the limits of 0.43^s and 1.93^s (a range of 1.50^s). The range for the different varieties decreased progressively as the number of components increased. [Extremes for 1-pause-1-syllable = 1.75^s and 0.43^s (range, 1.32^s); for 1-pause 2-syllable = 1.66^s and 0.43^s (range, 1.23^s); for 1-pause-3-syllable = 1.47^s and 0.45^s (range, 1.02^s); for 1-pause-4-syllable = 1.93^s and 0.85^s (range, 1.08^s).]

The longest and shortest averages were: for the 1-pause-1-syllable interval, 1.34^s and 0.47^s (range, 0.87^s); for the 1-pause-2-syllable, 1.26^s and 0.71^s (range, 0.55^s); for the 1-pause-3-syllable, 1.31^s and 0.75^s (range, 0.56^s). The different records of the same person, as well as those of different persons, gave a wide range of differences for the lengths of the different averages.

Approximately 80% of the extremes of the 1-pause-1-syllable, and 62% of the 1-pause-2-syllable intervals were extremes of excess. The balance were deficiency extremes. Of all the different varieties, about 70% were extremes of excess, 20% of deficiency and 10% of equality.

No intervals are of equal duration. The average inequality for the five different modes of composition was about 0.17^s, or 18% of the duration.

The most frequent mode of composition, both in prose and in poetry, was the 1-pause-2-syllable. It was about 8% more frequent in the records of poetry than in those of prose (52% of all modes).

The 1-pause-5-syllable, followed by the 1-pause-4-syllable, was the most infrequent mode of collocation. Both were less frequent in poetry than in prose. (In records of prose, the former = 4%, the latter 11%; in those of poetry both = 0%.)

On the basis of the 10% standard, 16% of the 1-pause-1-syllable, 6% of the 1-pause-2-syllable and 9% of all composite-centroid intervals are rhythmically coordinated.

Comparison of sound-centroid and composite-centroid intervals.—The average composite-centroid interval of speech occupies about 1.90 times more time than the sound-centroid interval.

The extremes of both are predominantly extremes of excess, the percentage for the composite being about 1.20 times higher than for the sound-centroid intervals.

The range for a given composite interval of speech is likely to be about 1.80 times larger than that for a given sound-centroid interval.

The latter is relatively one and a half times more regular than the former.

The difference in the length of the several modes of composition of the two kinds of intervals is more pronounced, and less variable, in the case of the sound-centroid intervals.

In both, the 2-syllable mode of composition (over 50% of all modes) occurs most frequently and the 5- and 4-syllable combination least frequently.

(a) *The distribution of the syllables of centroid intervals.—Modes of distribution.* In the 1-syllable interval, the centroid extends throughout its entire length. This interval is customarily called a spondee. The definition of this as "a foot consisting of two equally accented syllables," is based upon the misconception that a centroid interval consists of more than one centroid. When the components of a series of intervals are equally strong (are real centroids as the theory supposes) each centroid constitutes a so-called foot: there is no reason for including two centroids in the interval, rather than three or four, or all in a spondaic verse. The spondee of prosody is thus based upon a misconception and a certain arbitrariness. The spondee, to mean anything, should signify a 1-syllable centroid interval; and as signifying this, it may be a convenient term. It is arbitrary and unwarranted to include two centroid intervals in one interval.

The 1-syllable interval is limited to short sequences. In long ones the tendency is to so emphasize certain of the centroids as to make the others subordinate.

The 2-syllable interval admits of two situations: (1) a non-centroidal followed by a centroidal syllable (the iambus, ~ -). Here the centroid closes the interval, unlike the next; (2) a centroidal followed by a non-centroidal syllable (the trochee, - ~).

The components of the 3-syllable interval admit of this distribution: (1) two non-centroidal syllables followed by one centroidal (the anapest, ~ ~ -); (2) one centroidal followed by two non-centroidal syllables (the dactyl, - ~ ~); (3) one non-centroidal, one centroidal and one non-centroidal syllable (the amphibrach or amphiambus, ~ - ~).

In the 4-syllable interval this distribution is possible: (1) one centroidal followed by three non-centroidal syllables; (2) three non-cen-

troidal syllables followed by one centroidal. This interval appears to be generally the opening interval of a sequence. No names have been applied to these two modes; (3) one centroidal, two non-centroidal, followed by one centroidal syllable, (the *choriam*, — ~ —, in ancient prosody). This mode is spurious, if the centroidal syllables are genuine centroids.

Bearing on the conceptions and nomenclature of prosody.—Our treatment of the centroid and centroid interval suggests two general lines of criticism.

First, as long ago pointed out by SHELLEY,¹ the distinction between "measured" and "unmeasured" speech is unscientific. Both prose and poetry contain centroids and centroid intervals, following the same laws of composition and distribution. It is inadmissible to restrict the application of "measure" or "foot" to poetry alone. Centroid intervals pervade all uttered language.

Second, as pointed out by GURNEY, the terms "foot," "measure" or "bar" are inapt. "The arrangement of the foot is a mere matter of the eye. Nothing can prevent ictus from being ictus."² The fundamental concept of the centroid interval in speech is that of a unitary whole, juxtaposed to, and coalescent with, other similar wholes, requiring a portion of time for the voice to pass over its sounds. These intervals between force centers may be called centroid-intervals, bars, feet, or measures. But, unless interrupted by pauses, no divisions or "bars" exist between them. Nor are centroid-intervals to be conceived as a succession of bars of invariable length, nor as "feet" of similar length, nor as successive quanta of time conforming to an invariable "measure." Moreover, these terms, besides being customarily restricted to poetry, are applied with different meanings to classical and modern poetry.³ "In English poetry ----- the names of feet denote groups of accented and non-accented syllables, without reference to quantity" (ABBOTT and SEELEY). On the whole, the term centroid interval seems preferable.

Third, a convenient nomenclature for the different modes of distribution of the centroidal and non-centroidal syllables of the intervals is desirable. The old terminology of prosody is perhaps associated with misconceptions, as already indicated with reference to the spondee and choriam.

Fourth, there is no physical distinction between the several *types* of the different modes of distribution. There may be a mental, or felt,

¹ SHELLEY, A Defense of Poetry, Works, VII 6, London 1880.

² GURNEY, The Power of Sound, 426, London 1880.

³ ELLIS, The Quantitative Pronunciation of Latin, 5, London 1874.

difference between the iambus and trochee, and the anapest and dactyl; but physical measurements of them always extend from centroid to centroid, independently of type differences. The modes of distribution are, upon the whole, the same in prose and poetry. Prose, however, observes no systematic arrangement of the different kinds of intervals throughout the sentences in this respect. In poetry, the verses of a given stanza are supposed to consist of intervals of the same mode of distribution, or, if of different modes, to follow an orderly arrangement.

The succession or recurrence of centroid intervals.—As recurrences within sequences, they may be divided into two classes. In the *complex centroid intervals* are included all the intervals occurring between the first and the last centroid of a given record, irrespective of the composition of the intervals. It includes sound-centroid and composite-centroid intervals.

Simple-centroid intervals include all those occurring within expiration groups, or all the varieties of sound-centroid intervals. The latter were studied, not as successive members of rhythmical sequences, but as intervals, whether in isolation or succession, different in composition and time-value.

Each expiration group is an uninterrupted sequence of simple-centroid intervals. A pause destroys this continuity.

A comparison of these two intervals, the one including pauses, the other not, will determine the *differentia* of language rhythm, the function of the pause, etc.

Measurements of complex-centroid intervals.

TABLE LIX.

(*Reading scansion, English poetry*)

Subject.	a	p	$\frac{p}{a}$	e	c	n
J. W. R	0.74	0.29	0.38	1.81	+	115
E. W. S.	0.52	0.10	0.19	+ 1.12 — 0.33	+	102
A. D. B. _A	0.75	0.25	0.33	+ 1.68 — 0.25	+	24
A. D. B. _B	0.72	0.16	0.22	+ 1.47 — 0.27	+	16
W. W.	0.60	0.21	0.35	+ 1.66 — 0.45	+	101
A. R. P.	0.51	0.15	0.29	+ 1.20 — 0.18	+	15
Av.	0.64	0.19	0.29	+ 0.27	—	—

TABLE LX.

(Reading scansion, Japanese poetry)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. K.	0.32	0.06	0.18	+ 0.52 — 0.16	+	13
I. M.	0.39	0.16	0.42	+ 1.11 — 0.18	+	14
K. H. K.	0.72	0.27	0.37	+ 1.54 — 0.31	+	15
Av.	—	—	—	—	—	—
	0.47	0.16	0.32			

TABLE LXI.

(Sing-song and doggerel scansion)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
H. Ö.	0.65	0.16	0.24	+ 1.37 — 0.47	+	31
O. S.	0.68	0.13	0.19	+ 1.31 — 0.47	+	28
Av.	—	—	—	—	—	—
	0.66	0.14	0.21			

TABLE LXII.

(Routine scansion)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
E. H. T. _A	0.50	0.07	0.14	+ 0.70 — 0.31	+	15
E. H. T. _B	0.48	0.02	0.04	+ 0.58 — 0.43	+	15
Av.	—	—	—	—	—	—
	0.49	0.04	0.09			

TABLE LXIII.

(Summary of complex-centroid intervals of poetry)

Table.	<i>a</i>	<i>p</i>	$\frac{p}{a}$
LIX.	0.64	0.19	0.29
LX.	0.47	0.16	0.32
LXI.	0.66	0.14	0.21
LXII.	0.49	0.04	0.09
Av.	0.55	0.13	0.22

TABLE LXIV.

(Prose)

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
G. A. A.	0.55	0.19	0.32	+ 1.47 — 0.22	+	71
W. L. P.	0.70	0.28	0.40	+ 1.93 — 0.23	+	35
C. O. S.	0.63	0.17	0.26	+ 1.45 — 0.20	+	61
Av.	0.62	0.21	0.32		—	—

TABLE LXV.

(Poetry read as prose)

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. M. T.	0.46	0.13	0.27	+ 0.85 — 0.14	+	48
C. O.	0.48	0.14	0.29	+ 1.02 — 0.18	+	47
W. C.	0.62	0.22	0.35	+ 1.42 — 0.22	+	33
S.	0.67	0.21	0.31	+ 1.65 — 0.27	+	31
Av.	0.56	0.17	0.30		—	—

TABLE LXVI.

(Poetry read as prose without punctuation marks)

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. M. T.	0.45	0.12	0.26	+ 0.85 — 0.16	+	19
G. F. A.	0.51	0.16	0.31	+ 1.12 — 0.24		44
B. S. G.	0.66	0.19	0.28	+ 1.50 — 0.20	+	32
Av.	0.54	0.16	0.28		—	—

TABLE LXVII.

(Poetry read as poetry, Browning verses)

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. M. T.	0.52	0.18	0.34	+ 1.09 — 0.16	+	48
C. O.	0.45	0.16	0.35	+ 1.06 — 0.16	+	47
Av.	0.48	0.17	0.34		—	—

TABLE LXVIII.

(Poetry read as poetry, Tennyson verses)

Subject.	α	β	$\frac{\beta}{\alpha}$	e	c	n
W. C.	0.66	0.20	0.30	+ 1.52 — 0.22	+	33
S.	0.77	0.21	0.27	+ 1.47 — 0.25	+	32
Av.	0.71	0.20	0.28		—	—

TABLE LXIX.

(Summary of complex-centroid intervals of verses of Browning and Tennyson read as poetry)

Table.	α	β	$\frac{\beta}{\alpha}$
LXVII.	0.48	0.17	0.34
LXVIII.	0.71	0.20	0.28
Av.	0.59	0.18	0.31

TABLE LXX.

(Prose read as poetry)

Subject.	α	β	$\frac{\beta}{\alpha}$	e	c	n
S. I.	0.61	0.17	0.27	+ 1.25 — 0.32	+	21
O. E. S.	0.69	0.20	0.29	+ 1.37 — 0.21	+	23
Av.	0.65	0.18	0.28		—	—

TABLE LXXI.

(Summary of complex-centroid intervals of speech)

Table.	α	β	$\frac{\beta}{\alpha}$
LXIII.	0.55	0.13	0.22
LXIV.	0.62	0.21	0.32
LXV.	0.56	0.17	0.30
LXVI.	0.54	0.16	0.28
LXIX.	0.59	0.18	0.31
LXX.	0.65	0.18	0.28
Av.	0.58	0.17	0.28

 α , Unit of measurement, 1^s. e , extreme intervals. α , average duration. c , character of greater extreme. β , immediate probable error. n , number of intervals. $\frac{\beta}{\alpha}$, relative immediate probable error.

Results.—The number of intervals measured was 1054.

The duration of a given complex-centroid interval in speech will probably fall somewhere within the limits of 0.14^s (= shortest in series, J. M. T., Table LXV.), and 1.93^s (= longest in series, W. L. P., Table LXIV.), a range of about $1\frac{3}{4}^s$. The range for the average interval of different records is about $\frac{1}{4}$ of this (from 0.32^s , J. K., Table LX. to 0.75^s , A. D. B., Table LIX.), and for the averages of different sets of records less than $\frac{1}{7}$ (from 0.47^s , Table LX. to 0.71^s , Table LXVIII.). The highest range between the averages of the selections read twice by the same person was 0.10^s (S.); the lowest, 0.03^s (C. O.).

The extreme deviations of these intervals from the average were always of the nature of excesses. In the measurements 100% were plus extremes. This may be due more to the pauses than the brevity of the average. The former enables the range to be extended almost indefinitely, while it can be only slightly abbreviated. The extremes for the different sets, may be obtained in the *e* and *c* columns of the tables.

The length of the average complex-centroid interval is a little over half a second (0.58^s).

The averages in prose (0.59^s) and poetry (0.57^s) are practically equal in length. The tendency, just barely perceptible, is to make the intervals of prose the longer. This conclusion may only hold for such intervals as were measured, which were prevailingly 2-syllable sound- and 1-pause-2-syllable composite-intervals.

The longest average in any record was 0.07^s shorter in prose (0.70^s , W. L. P.), than in poetry (S., Table LXVIII.); and the shortest average was 0.10^s shorter in the reading scansion of English poetry (C. O., Table LXVII.) than in prose (0.55^s , G. A. A.).

The intervals composed regularly of two syllables (0.71^s = average for set of Tennyson verses; 0.66^s , same for sing-song and doggerel scansion) are longer than those composed of a mixture of one, two, three, four and five syllables, provided the number of 1-syllable intervals is relatively larger than the number of 3-, 4- and 5-syllable intervals.

The average inequality of the lengths of complex-centroid intervals in all varieties of speech was about 0.17^s or 28% of the length of the average.

The regularity in a given set of records of a variety of verses of poetry of the predominantly 2-syllable type, scanned according to the four types of scansion, was about 8% higher than that for the intervals in a given number and variety of sentences of prose, uttered in various ways. The irregularity for the former was 22% (Tables LIX., LXI., LXII., LXIX.); of the latter, 30% (Tables LXIV., LXX.).

The regularity in a given set of records of English poetry, the intervals of which are mostly of the 2-syllable pattern, and the scansion of

which is rhythmically free (reading scansion, Table LIX.) was about 3% higher than that in a corresponding set of records of English prose, the reading of which is rhythmically free (32%, Table LXIV.). When the scansion or reading is natural, artistic and rhythmically free, the complex-centroid intervals are only slightly more regular in poetry than in prose.

The most regular coordination of the intervals in prose (e. g., C. O. S., Table LXIV.; and Table LXX.) was superior to the coordination in many records of poetry.

The most regular coordination in poetry occurs in routine scansion; it is never perfect. The lowest percentage in seventeen records was 4% (Table LXII.; E. H. T._B). Beating the time with the finger increased the regularity about three and a half times.

The intervals in the most regular scansion of poetry were about six and one-half times more regular than in the most regular reading of prose. Excluding the record of routine scansion with regulative concomitant, this is reduced to one and six-sevenths.

The coordination in doggerel and in the most regular specimen of reading scansion, was about equally good (19%, O. S., Table LXI., and E. W. S., Table LIX.). In routine scansion it was about twice as regular as this (9%, Table LXII.).

In sing-song scansion it was slightly poorer than in doggerel scansion, but better than in reading scansion in general. Reading scansion represents the highest degree of irregularity of any form of scansion.

The test records of the verses of Tennyson and Browning indicate that the highest regularity in reading scansion occurs when the intervals consist of a uniform mode of composition or the same number of syllables (cf. Tables LXVII. and LXVIII.). The difference in the regularity of the renderings of the tests is small. The absence of the punctuation marks did not decrease it.

The range of irregularity for the records of a given number of persons will be about 0.27^s (from 0.02^s, routine scansion, Table LXII. to 0.29^s, reading scansion, J. W. R., Table LIX.), or 38% (0.04 to 0.42, reading scansion, Japanese poetry, I. M., Table LX.). The range for the averages of the sets was 25% (from 9%, routine scansion, to 34%, verses of Browning read as poetry, Table LXVII.); and for the same persons repeating the same selections 7% (from 1% to 8%, in both cases, J. M. T.).

With a standard of 10% of inequality, the complex-centroid intervals are rhythmically coordinated in about 6% of the records of poetry and in none of those of prose. With 15% as the standard none of the

latter and 12% of the former satisfy the demands of rhythm (this is exclusive of the test records read as prose, both with and without punctuation marks).

The above items for the individual records (test records, records of foreign languages, etc.) may be obtained in the tables.

Measurements of simple-centroid intervals.

TABLE LXXII.
(*Reading scansion, English poetry*)

Subject.	a	p	$\frac{p}{a}$	e	c	n
J. W. R.	0.63	0.11	0.17	+ 1.12 — 0.33	+	91
E. W. S.	0.44	0.05	0.11	+ 0.62 — 0.25	—	74
A. D. B. A.	0.47	0.12	0.25	+ 0.79 — 0.27	+	11
A. D. B. B.	0.60	0.06	0.10	+ 0.81 — 0.27	+	9
W. W.	0.41	0.10	0.24	+ 0.97 — 0.18	+	64
A. R. P.	0.43	0.06	0.14	+ 0.57 — 0.27	—	11
Av.	0.50	0.08	0.17		—	—

TABLE LXXIII.
(*Reading scansion, Japanese and Persian poetry*)

Subject.	a	p	$\frac{p}{a}$	e	c	n
J. K.	0.32	0.06	0.18	+ 0.52 — 0.16	+	12
I. M.	0.34	0.10	0.29	+ 0.60 — 0.18	+	13
K. H. K.	0.53	0.08	0.15	+ 0.68 — 0.31	—	12
Av.	0.39	0.08	0.20		—	—

TABLE LXXIV.
(*Sing-song and doggerel scansion*)

Subject.	a	p	$\frac{p}{a}$	e	c	n
H. Ö.	0.50	0.04	0.08	+ 0.55 — 0.47	+	21
O. S.	0.59	0.04	0.06	+ 0.78 — 0.47	+	21
Av.	0.54	0.04	0.07		—	—

TABLE LXXV.

(Routine scansion)

<i>Subject</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
E. H. T. _A	0.47	0.06	0.12	+ 0.70 — 0.31	+	12
E. H. T. _B	0.48	0.01	0.03	+ 0.52 — 0.43	—	12
Av.	—	—	—	—	—	—
	0.47	0.03	0.07			

TABLE LXXVI.

(Summary of simple-centroid intervals of poetry)

<i>Table.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$
LXXII.	0.50	0.08	0.17
LXXIII.	0.39	0.08	0.20
LXXIV.	0.54	0.04	0.07
LXXV.	0.47	0.03	0.07
Av.	0.47	0.06	0.13

TABLE LXXVII.

(Prose)

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
G. A. A.	0.44	0.10	0.22	+ 0.70 — 0.20	+	51
W. L. P.	0.44	0.12	0.27	+ 0.83 — 0.23	+	36
C. O. S.	0.54	0.11	0.20	+ 0.80 — 0.20	—	42
Av.	—	—	—	—	—	—
	0.47	0.11	0.23			

TABLE LXXVIII.

(Poetry read as prose)

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. M. T.	0.37	0.10	0.27	+ 0.68 — 0.14	+	34
C. O.	0.36	0.08	0.22	+ 0.62 — 0.18	+	31
W. C.	0.44	0.07	0.15	+ 0.60 — 0.22	—	22
S.	0.50	0.06	0.12	+ 0.75 — 0.27	+	20
Av.	—	—	—	—	—	—
	0.41	0.08	0.19			

TABLE LXXIX.

(Poetry read as prose without punctuation marks)

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
G. F. A.	0.38	0.08	0.21	+ 0.60 — 0.24	+	29
B. S. G.	0.49	0.11	0.22	+ 0.75 — 0.20	—	17
J. M. T.	0.36	0.10	0.27	+ 0.72 — 0.16	+	32
Av.	0.41	0.09	0.23	—	—	—

TABLE LXXX.

(Poetry read as poetry, verses of Browning)

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
J. M. T.	0.38	0.09	0.23	+ 0.75 — 0.16	+	48
C. O.	0.30	0.06	0.20	+ 0.50 — 0.16	+	31
Av.	0.34	0.07	0.21	—	—	—

TABLE LXXXI.

(Poetry read as poetry, verses of Tennyson)

<i>Subject.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
W. C.	0.48	0.09	0.18	+ 0.65 — 0.22	—	21
S.	0.55	0.09	0.16	+ 0.85 — 0.25	0	18
Av.	0.51	0.09	0.17	—	—	—

TABLE LXXXII.

(Summary of simple-centroid intervals of verses of Browning and Tennyson, read as poetry)

<i>Table.</i>	<i>a</i>	<i>p</i>	$\frac{p}{a}$
LXXX.	0.34	0.07	0.21
LXXXI.	0.51	0.09	0.17
Av.	0.42	0.08	0.19

TABLE LXXXIII.

(Prose read as poetry)

Subject.	<i>a</i>	<i>p</i>	$\frac{p}{a}$	<i>e</i>	<i>c</i>	<i>n</i>
S. I.	0.46	0.07	0.15	+ 0.70 — 0.32	+	13
O. E. S.	0.53	0.13	0.24	+ 0.90 — 0.21	+	15
Av.	0.49	0.10	0.19	—	—	—

TABLE LXXXIV.

(Summary of simple-centroid intervals of speech)

Table.	<i>a</i>	<i>p</i>	$\frac{p}{a}$
LXXVI.	0.47	0.06	0.13
LXXVII.	0.47	0.11	0.23
LXXVIII.	0.41	0.08	0.19
LXXIX.	0.41	0.09	0.23
LXXXII.	0.42	0.08	0.19
LXXXIII.	0.49	0.10	0.19
Av.	0.44	0.08	0.19

Unit of measurement, 1".

e, extreme intervals.*a*, average duration.*c*, character of greater extreme.*p*, immediate probable error.*n*, number of intervals. $\frac{p}{a}$, relative immediate probable error.*Results*.—Eight hundred and twenty-three measurements were made.

The duration of a given simple-centroid interval of speech will presumably lie somewhere between 0.14" (J. M. T., Table LXXVIII.) and 1.12" (J. W. R., Table LXXII.), a range of about 1 second. The range for the averages of a given series of records will be about $\frac{1}{3}$ of this (from 0.30", C. O., Table LXXX., to 0.63" J. W. R., Table LXXII.); and for those of different sets, about $\frac{1}{5}$ (from 0.34", verses of Browning read as poetry, to 0.54", sing-song and doggerel scansion). The highest range for the selections repeated by the same person was 0.06" (C. O.); the lowest, 0.01" (J. M. T.). For the complex intervals J. M. T.'s range was the highest; here it is the lowest. He seems most irregular in his pauses.

The longest average for any set of prose records was 0.49" (Table LXXXIII.); for poetry, 0.54" (Table LXXIV., sing-song and doggerel scansion). The shortest for poetry was 0.34" (Table LXXX., Browning verses). The longest average for any record was 0.54" for prose (prayer,

C. O. S., Table LXXVII.), and 0.63^s for poetry (J. W. R., Table LXXII.); the shortest for prose, 0.44^s (G. A. A., Table LXXVII.), and for poetry, 0.30^s (C. O., Table LXXX.). The range seems larger in poetry.

In 69% of the records the largest deviations from the average were those of excess; in 27%, of deficiency; and about 3% were equal.

The average duration of these intervals for different kinds of speech is somewhat below half a second (0.44^s). This corresponds closely with MEUMANN's period (0.40^s) for purely subjective rhythmisation.

The averages for a variety of sentences of English prose (0.48^s) and a variety of verses of English poetry (0.46^s) are practically equal. The tendency, barely perceptible, is towards a longer interval in prose. The intervals in the poetry measured were predominantly 2-syllable.

The average is longer in verses consisting uniformly of 2-syllable intervals, than in verses consisting of a haphazard alternation of 1-, 2-, 3-, 4-, and 5-syllable intervals, provided that the number of 1-syllable is higher than the number of 3-, 4-, and 5-syllable intervals. The average for the verses of Tennyson was 0.51^s; for those of Browning, 0.34^s (Table LXXXII.). The latter contained numerous 1-syllable intervals. So did those of Byron where the average was 0.41^s (W. W., Table LXXII.).

The inequality in the lengths of these intervals in various kinds of speech is about 0.08^s, or 19% of the average length.

The regularity for a given series of records of a variety of poetical verses of the predominantly 2-syllable type of intervals, scanned according to the four types of scansion will be about 8% higher than that for records of a variety of prose sentences spoken in various ways (21%, av. irregularity of Tables LXXVII. and LXXXIII.). This is exclusive of the Japanese and Persian records. For records of English verses composed mainly of the 2-syllable pattern, the scansion of which is rhythmically free, it will probably be about 6% higher than for records of English prose, the rendering of which is rhythmically free (irregularity 23%, Table LXXVII.).

The most regular coordinations in prose (15%, S. I.; 20%, C. O. S.) may often be higher than some coordinations in poetry (cf. A. D. B._A, W. W., J. M. T., C. O., etc.).

The intervals in the most regular type of scansion of poetry (E. H. T._B, Table LXXV.) were about five times more regular than in the most regular reading of prose (15%, S. I., Table LXXXIII., melodious prose). Excluding the record of routine scansion with regulative concomitant, the regularity was two and a half times greater.

The most regular coordination of the intervals in poetry is never perfect. The lowest observed percentage of irregularity in seventeen records was 3%.

The highest regularity occurred in the type of routine scansion accompanied by beating time. This type represents the acme of regularity in the accentual or centroid rhythm of speech.

The coordination in sing-song (irregularity, 8%) and doggerel scansion (irregularity, 6%) may be approximately the same. Both are fully twice as irregular as mechanically regulated (routine) scansion.

The most regular coordination in reading scansion (10% of irregularity, A. D. B._B) is slightly inferior to the coordination in sing-song scansion. The regularity in reading scansion is the most inexact of all the types of scansion of poetry. It is most exact, other things equal, when the intervals are composed quite uniformly of the same number of syllables (contrast Tennyson's verses with Browning's and Byron's). The regularity in the reading of the selections as prose and poetry was the same. When the punctuation marks were eliminated, it was only slightly increased.

The range in the irregularity of the intervals in various kinds of speech may be about 0.11^s (from 0.01^s, routine scansion, to 0.12^s, A. D. B._A, poetry, and W. L. P., prose), or 26% (from 3%, routine scansion, to 29%, Japanese poetry). The range for the different sets was 16% (from 7%, Tables LXXIV. and LXXV., to 23%, Tables LXXVII. and LXXIX.), or about $\frac{2}{3}$ of the former (the individual records); and for the repeated readings by the same person, 2% (from 2%, C. O., to 4%, J. M. T. and S.).

According to the 10% standard, 23% of the records of poetry are rhythmical, exclusive of records of poetry read as prose, both with and without punctuation marks. With a standard of 15%, 46% of the records of poetry, and 20% of the records of prose (record of melodious prose), are rhythmical. Even in the latter case, more than one-half of a fairly comprehensive collection of speech records was non-rhythmical.

Comparison of complex- and simple-centroid intervals.

The range for the former was approximately 1.80 times that for the latter.

The general character of the extreme deviations was the same for both. For the complex, however, they were uniformly, for the simple chiefly excess extremes.

The average for the complex was 0.14^s, or 1.31 times, longer than for the simple intervals.

The averages of both were very slightly longer in prose than in poetry. This is probably due (1) to the composition of the intervals. In the prose records the longer intervals (3-, 4-, and 5-syllable) were relatively more numerous. (2) The tendency in poetry, especially in routine and doggerel scansion, to rhythmize the pause; this limits its length.

Both intervals had the longest averages in verses consisting of the uniform 2-syllable type.

The coordination was about $1\frac{1}{2}$ times more regular for the simple than for the complex.

The difference was less between the regularity of the simple intervals in poetry and prose, than between the regularity of the complex in poetry and prose.

For the reading scansion of English poetry and prose, the difference was twice as large for the complex as for the simple.

In the most regular type of scansion, the regularity was slightly higher for the simple than the complex. The beating of time increased the regularity of the former most. Relatively to other types of scanning, however, it greatly increased the regularity of the complex intervals.

The range of irregularity for a variety of speech of different persons was about $1\frac{1}{2}$ times larger (1.46) for the complex than for the simple intervals.

With a provisional standard of 15%, the simple intervals were rhythmically coordinated in about four times as many records of poetry as were the complex.

General deduction.—The most perfect manifestation of centroid rhythm in speech never reaches the zero point of irregularity. This point is most nearly approached in simple-centroid intervals of uniform composition, mechanically scanned.

Bearing on the rhythmic function of the pause.—The facts reached regarding the duration and regularity of sound and composite, and single and complex intervals necessitate a revision of the prevalent notion of the pause as compensatory,¹ as the rhythmical equivalent for a missing syllable or a foot. POE² so regards the cæsura. We have seen that the introduction of the pause uniformly disturbs the rhythm of the centroids. The records without exception show this. The coordination of the complex intervals was almost without exception so irregular as to defy rhythmisation. In only two records does the inequality fall to 15%,

¹ LANIER, *The Science of English Verse* 189, New York 1880.

GUEST, *A History of English Rhythms*, 77, London 1882.

² POE, *The Rationale of Verse*, Works, VI 89, Chicago 1895.

while for the simple intervals, there are eight such records of poetry and one of prose. The pause constitutes the one rhythmical ; the other, in the main, non-rhythmical. It creates two alternating, though interpenetrating, sequences within the unity of the discourse ; the one consisting of expiration intervals, being rhythmical, the one consisting of expiration and vacant intervals, being non-rhythmical.

We saw that the terminal pauses, which were longer and more regular than the sectional, unified the verses. The tables for the sectional pauses and the simple and complex intervals show that when the number of sectional pauses is large the coordination of the intervals is poor. When they occur quite regularly in long verses these are split up into two. Most of those reading the Browning verses written as prose who made regular sectional pauses, when asked to write the sentences as verses, doubled the number. Here the pauses segregated the verses into two parts. Both the terminal and sectional pauses may thus become rhythmically recurrent, provided they recur at fairly regular intervals and are of fairly regular length.

Rhythmically, pauses check the continuity of the centroid rhythm of speech ; they limit the length of centroid sequences. This makes centroid rhythm essentially *discontinuous*, an alternately interrupted and recommencing flow, an inter-pause rhythm. Mechanical rhythm, e. g. clock ticks, consists of continuous sequences of coordinated intervals.

Pauses also assist in imparting a felt unity to sequences of several centroid intervals, provided they follow a certain law, whence arises a secondary rhythm, that of vacant and expiration intervals. Thus we get the verse interval rhythm.

Psychologically, the pause serves to avert the monotony of long sequences of regularly recurrent stimuli. The length of these will affect the quality of the rhythm. Too long or too short series are objectionable. This may differ for different kinds of scansion and rhythmisation. In subjective rhythmisation a continuance of clicks for 45 seconds has been found favorable, for 70 seconds disgusting.¹ The pause thus contributes change, variety, relaxation, and also a complex feeling of rhythm due to the involution or interpenetration of the two orders of rhythm.

Bearing on some phases of speech rhythm.—(a) *The elements of rhythm.*—Speech rhythm has been defined as a “law of succession” (GUEST); a “principle of proportion introduced into language,” “inferior meter” (SEELEY and ABBOTT); “periodic stimulation of sounds or of a small group of sounds” (GURNEY); “the succession and involution of unities, that is, unities within unities, applicable to feet, verses and stanzas”

¹ TITCHENER, Experimental Psychology, I II 340, New York 1901.

(CORSON); "a system of accentuation" (HEGEL); "a succession of tones in various length and shortness, following in a certain time form" (LOBE); "the coordination of speech sounds in time and duration" (LANIER). In these definitions are involved two theories.

(1) The "*time theory*," holding that the element of time is fundamental, and emphasis subordinate. The sounds of a rhythmical sequence must, above all things, be coordinated, periodical. LANIER¹ ("simple time relations"), GURNEY² ("a fixed scheme of recurrence"), BOLTON³ (regular recurrence the most important element; "accentuated sounds form a secondary rhythm out of the primary"), HAUPTMANN,⁴ WESTPHAL,⁴ LOBE,⁴ HERBART,⁴ LOTZE,⁴ SCHOPENHAUER,⁴ and EDWARDS,⁵ may be cited as representatives.

(2) The "*accentualist theory*," making emphasis the essence, and time a secondary element. Some of the exponents are GUEST⁶ ("accent the sole principle," "rhythm of accent independent of quantity"), HEGEL⁷ ("rhythm a system of accentuation"), GUMMERE,⁸ and KOSTLIN⁹ ("change of accents of the tones").

It is hard to pin the writers down to any one statement, but the positions seem to be as indicated. When accent is made primary the element of time becomes, at best, merely "a regulative principle or a principle of embellishment." The opposite rigorist holds that no number of accents, nor manner of variation of the elements, can render sounds rhythmical unless they are strictly periodic.

The centroid theory of speech rhythm emphasizes the truth contained in both of these theories. No recurrence of centroids can be rhythmized unless the length and regularity of the intervals fulfil the requirements of the rhythmical time-sense. This may differ slightly for different individuals. It may allow of slight grades of rhythm, bad, good, excellent. At a certain point, however, the rhythmic perception or feeling ceases entirely.

The criterion of regularity may also differ for the different kinds of rhythms, sensory and motor, speech, music, walking, dancing, etc. For routine scansion, with the attention focused on the regularity, the crite-

¹ LANIER, *The Science of English Verse*, III., New York 1880.

² GURNEY, *The Power of Sound*, 439, London 1880.

³ BOLTON, *Rhythm*, Am. Jour. Psych., 1893 VI.

⁴ MEUMANN, *Untersuchungen zur Psychologie und Aesthetik des Rhythmus*, Philos. Stud., 1894 X 250.

⁵ GUEST, *A History of English Rhythm*, 108, London 1882.

⁶ GUEST, as before, 108-110.

⁷ HEGEL, *Aesthetic*, trans. of Kedney, 257.

⁸ GUMMERE, *Handbook of Poetics*, 137, Boston 1885.

⁹ MEUMANN, *Philos. Stud.*, 1894 X 250.

rion may be higher than for reading scansion, where the best expression of thought is essential. A variation (+ and -) of $\frac{1}{60}$ of empty intervals between clicks 4.27^s in length was always correctly noticed in the experiments of HALL and JASTROW;¹ one of $\frac{1}{120}$, nearly always.

These requirements, however, give only subjective or objective periodicity. Grouping may be temporally perfect or periodic (Lanier's primary rhythm), and still not be psychologically rhythmical. To constitute perceived rhythms, some member of the groups must be accentuated, at least subjectively. Walking may be periodic; it is not normally rhythmical. It becomes rhythmical when one step is made more energetic, or when attention is given to it, or a sound is uttered or heard (*e. g.*, a drum) as it descends.

EBBINGHAUS² found that the coordination of the lengths of syllables spoken loud was impossible without differences of accent: no rhythmisng of syllables mechanically uttered was possible. In repeating the numerals 1-10 regularly, I could feel no rhythm until some numbers were subordinated, *i. e.*, formed into centroid intervals. Then grouping soon became inevitable. A trained vocalist sang the vowel \ddot{o} into the phonograph without interruption for nearly 40^s . He was told to make it perfectly smooth, without modification in intensity and pitch. The resulting sound was fairly smooth at the beginning; after about 10^s oscillations in the intensity were noticeable. Speech as a motor phenomenon is necessarily centroidal.

Emphasis is unavoidably imposed upon certain members of a sound sequence. Numerous experiments³ show that these are always formed into groups because of subjective emphasis.

The form of these groups will depend upon representative factors arising from the experience of the subject; they will conform to some represented rhythm (counting, beating time, clock beats, pendulum swings, puffs of the engine, etc.).

In BOLTON's⁴ experiments the normal, easiest or psychologically prior form was the 2-group (first syllable accented, trochee) and 4-group. The 3-group (dactylic form easiest) and 2 + 3-group were readily suggested, but not the 5-group. HALL and JASTROW⁵ found that in *counting* a series of sounds or clicks 3- and 4-groups must be farther apart than

¹ HALL AND JASTROW, *Studies of rhythm*, Mind, 1886 XI 61.

² MEUMANN, Philos. Stud., 1894 X 423, 424.

³ BOLTON, Am. Jour. Psych., VI 145-238.

EBBINGHAUS and DIETZE, in MEUMANN, Philos. Stud., 1894 X 423.

⁴ BOLTON, as before, 212, 216, 222.

⁵ HALL and JASTROW, *Studies of Rhythm*, Mind, 1886 XI 58, 61.

2-groups. Twenty-four to forty clicks per second were easily distinguished by the average ear [limit of ability to discriminate sounds = $\frac{1}{182}$ (HELMHOLTZ) or $\frac{1}{500}$ (EXNER) of a second]. Counting, however, involved naming of the clicks. The number-names are not of uniform ease and length. This influenced the grouping.

Thus the centroid, or the element of emphasis, is always present in speech. Consciousness is centroidal. Perceived rhythm is a highly regular alternation of intense and lesser intense states of consciousness.

(b) *The nature of rhythm.*—It is a series of mental events involving affection, intellection and conation. The rôle of the first has been stated by WUNDT¹ (feeling of strain and expectation, of unity, and a certain degree of emotion), by SMITH² (rhythm a progressive emotion with coordinated motor discharges), by MEUMANN³ (æsthetic feelings) and by LIPPS⁴ (associative æsthetic feelings). The latter are probably such as proportion, symmetry, unity in variety, harmony, euphony, beauty, sublimity. The emotions may be those of different degrees of pleasantness, ecstasy, joy, vivacity, erethic diathesis, orgasm, love, hate, sweetness, well-feeling, etc.; and perhaps disagreeableness—monotony, insipidity, sadness, discomfort, disgust, etc. The sense feelings may include smoothness, assonance, dissonance, intense or weak, long or short, fast or slow, excitations, freshness or tiredness, muscular activity or innervation, tingling, heightened temperature and blood pressure, etc.

MEUMANN⁵ (rhythm a perception) emphasizes the rôle played by intellection. This is best illustrated by the change of grouping produced by ideation (association factor). This factor will largely determine the character of the affectional response of the individual.

The present researches emphasize the factor of *conation*: without subjective emphasis, the centroid, no rhythm. Intellective perception alone may perceive periodicities, but not rhythm; for this conative perception, or intermittent attention, aroused and sustained by feeling, is necessary. *Felt motor* innervations are fundamental to rhythmic perception. They need not necessarily be *movements* or vaso-motor discharges, but motor impulses (probably only mental beats). Rhythm is a peculiarly *felt motor perception* of movement in time.

¹ WUNDT, Outlines of Psychology (Eng. tr.), 167, 176, Leipzig 1897.

² SMITH, Philos. Stud., 1900 XVI 291.

³ MEUMANN, Philos. Stud., 1894 X 264.

⁴ LIPPS, *Aesthetische Einfühlung*, Zeit. für Psychol. u. Physiol., CXXII 441.

⁵ MEUMANN, as above, 272, 284.

VI. COMPARISON OF INTERVALS IN SPEECH.

Tables of average number of syllables per centroid and expiration interval, and the interval of the unit of measurement (1^s).

TABLE LXXXV.

(Poetry)

Subject.	c	s	e
E. W. S.	2.21	4.22	6.42
J. W. R.	2.06	2.75	8.77
A. D. B.	2.15	2.90	3.73
W. W.	1.74	3.01	4.89
A. R. P.	2.00	3.73	6.00
H. Ö.	2.09	3.16	5.81
O. S.	2.10	3.10	7.80
J. M. T.	1.56	2.95	
C. O. B.	1.56	3.40	4.41
W. C. B.	1.90	2.90	4.26
S. B.	2.00	2.56	4.26
G. F. A.	1.65	3.13	4.56
B. S. G.	2.00	2.99	4.00
Av.	1.92	3.14	5.41

TABLE LXXXVI.

(Prose)

Subject.	c	s	e
G. A. A.	2.53	4.48	4.48
W. L. P.	2.20	3.14	6.05
C. O. S.	2.24	3.53	6.57
S. I.	2.71	4.38	6.33
O. E. S.	2.47	3.54	6.33
Av.	2.43	3.81	5.95

c, complex centroid intervals.

s, intervals of 1^s.

e, expiration intervals.

Results.—The average number of syllables for each complex centroid interval of all varieties of speech was 2.17.

For the records of poetry it was 1.92; for those of prose, 2.43, the latter being a trifle over 25% larger than the former. For verses composed predominantly of the 3-syllable type of intervals, this relation would probably be reversed. Since there is no orderly arrangement of interval pattern in prose, the variation, while it may be constant and sometimes large, will in the average be small (cf. records of Table LXXXVI.). The range between the highest and lowest average for

prose was 0.51 syllable; for poetry, 0.65 syllable. The range for the individual intervals was from 1 to 5 syllables. A centroid interval in speech may thus range from a 1-syllable to a 5-syllable.

The average number of syllables per second of time for all kinds of speech was 3.47; for the records of poetry, 3.14; for those of prose, 3.81, or about 20% more than for poetry.

The range for the averages of prose was 1.34 syllable per second (from 3.14 to 4.48); for poetry, 1.66 syllable (from 2.56 to 4.22), or about 23% larger than the range for prose.

On the basis of the general average, the number of syllables uttered per minute in speaking is approximately 208. This involves an equal number of changes in the action of the vocal cords. The most rapid contractions in aspirating *t* and *k* has been found to never exceed 6 double or 12 single contractions per second.¹

The average number of syllables per expiration interval for all kinds of speech was 5.68; for poetry, 5.41; for prose 5.95, or 10% more than for poetry.

The range for the averages of prose was 1.85 syllable; of poetry, 5.04, or nearly two and three-fourths times longer than the former.

This range applies only to the averages of ordinary expiration intervals, and not to those of maximum expiration intervals. The following test was made: The subject, after having inhaled as much air as the lungs would comfortably hold (attempting to make each inhalation equal) read as many of a variety of short and long words as was possible without replenishing the original supply of air. The test was stopped when fortuitous inhalations occurred. The tendency was to increase the rate as the context became familiar and practice set in. All the utterances were considerably more rapid than those in ordinary speech. Sometimes this increased the number of syllables; frequently it produced a more rapid expenditure of air, and decreased the number. Several relatively slow readings contained the largest number.

These were the average number of syllables for seven or eight tests each of 11 subjects: 122, 147, 148, 153, 163, 165, 187, 190, 230, 257, and 276. The general average is 182.5. The highest average came from a trained vocalist. Most subjects gained up to a certain point and then fell off. The lowest percentage of gain was 19 syllables; the highest 119. The range is 154 syllables (from 122 to 276).

Compared with the average normal interval, the average maximum contains approximately 32 times as many syllables. The range of a breath group may thus extend from 1 to about 175 syllables. The normal is

¹ HALL AND JASTROW, *Studies of rhythm*, Mind, 1886 XI 59.

the stock-in-trade of ordinary speech. The maximum is perhaps never reached in speech. The nearest approach is found in impassioned speech.

Comparison of intervals.—The average interval of the second was 0.60 syllable longer than the complex centroid interval, and 0.63 syllable shorter than the expiration interval. For the prose records, it was 0.56 syllable longer than the centroid interval, and the same shorter than the expiration interval. For poetry it was 0.63 syllable longer than the centroid, and 0.72 syllable shorter than the expiration interval.

The expiration intervals of poetry were 2.81 syllables longer than the centroid intervals of poetry and prose respectively.

The range between the longest and shortest averages of the tables was : for the centroid interval, 0.58 syllable ; for the second, 1.45 ; and for the expiration, 5.04. The average range for the second was 2.50 syllables longer than for the centroid, and 4.75 syllables shorter than for the expiration interval.

The difference between the range of syllables for the second and centroid interval was over 4 times the difference between the average number of syllables for each ; and the same for the second and expiration interval was 7.5 times the difference between the averages for each.

Character of the greater extreme.—This was for all the intervals of speech in the vast majority of cases of the nature of excess. In no case does the percentage fall below 59%.

The extremes were relatively least frequent in the verse intervals, and most frequent in the complex, vacant, expiration and simple centroid intervals in the order named. The converse order represents the grade of frequency of the deficiency extremes.

Only in the expiration and simple centroid intervals were there any equal extremes, the percentage in both cases being very small (6% and 3%).

May we say that the longer the average of the interval the smaller, and the shorter the larger, is the percentage of excess extremes? The average vacant and simple centroid intervals are equal in length, yet differ in the percentage of plus extremes. The complex are longer, yet have no minus extremes: all are *plus*. The simple intervals are considerably shorter than the expiration and complex, yet have a higher percentage of minus extremes than these—more than double as many as the vacant intervals.

Hence, other things being equal, the extremes of deficiency are relatively most infrequent and those of excess most frequent, in intervals containing pauses.

Range of duration for single intervals.—Taking the range for the simple centroid (0.98^s) as the norm, the range for the vacant was 1.37 longer, for the complex 1.82 , for the verse 4.20 , and for the expiration intervals 4.72 . The difference between the longest (4.65^s) and the shortest range is 3.57^s .

The range for the average of the complex intervals is 1.30 times that of the simple ($=0.33^s$) ; for the vacant 1.54 times ; for the expiration 5.60 times ; and for the verse 10.5 times. The longest range (3.47^s) is 3.14^s longer than the shortest. The order for the individual intervals and the averages is seen to differ. Both fall into two groups, the one a small, the other a large, range.

Average duration.—Taking the average of the simple centroid as the norm (0.44^s), the average for the vacant was of the same length ; for the complex, 1.31 times longer ; for the composite, 2.20 times longer ; for the expiration, 2.70 times longer ; and for the verse intervals, 6.11 times longer.

With the sum of the averages as the unit, the verse interval constitutes 42% , the expiration 19% , the composite 15% , the complex 9% , and the vacant and simple centroid 7% each, of this unit. The average for the verse intervals is about $2\frac{1}{4}$ times longer than for the expiration.

The proportion between the averages of the expiration and vacant intervals, or between the quantity of sound and silence in speech, was as 2.71 to 1 . Apparently about 73% of the time consumed in speaking is utilized in sound production and in exhalation, and 27% in pausing. Most pauses probably represent an inhalation.

The proportion of sound to silence was slightly larger for poetry than for prose. The difference is negligible. The largest percentage in English poetry for the expiration intervals was 79% (J. W. R. record) ; the smallest, 57% (W. C.).

The average for the composite intervals is nearly two and a fourth times larger than that for the vacant and simple. Hence the sounds in the composite intervals occupy more time than the silence.

All the above relations of the intervals in the various records, may be obtained in the tables.

Range of irregularity.—*In units of time*, with the range of the simple intervals (0.11^s) as the norm, that of the complex and vacant is each 2.45 times larger, of the verse 4.18 times and of the expiration 7.81 times. As a fraction of the average duration the range for the simple (26%) is $2\frac{1}{2}$ times that for the verse ; and for the complex 1.46 , for the vacant 1.65 and for the expiration 1.69 times that for the simple intervals.

Relative regularity.—The average for the verse intervals is 2.11 as regular as for the simple (19%); for the latter 1.47 times as regular as for the complex, 1.52 as regular as for the vacant, and 1.78 as regular as for the expiration intervals.

Percentage of records of rhythmically coordinated intervals.—Applying a 10% standard of irregularity, it is as follows: For verse, 59%; simple centroid, 14%; expiration, 12%; vacant, 8%, and complex centroid, 4%. The manner of coordination differs for the intervals. The expiration and vacant were picked out wherever they occurred in the records. The one intervenes between the other; the tables do not include the measurements of the two in one series. The verse intervals are likewise separated by terminal pauses. These are not included in calculating their rhythm.

Bearing on metrical problems.—If meter requires a relatively perfect coordination of intervals, what conditions are essential to fulfil this requirement? What type of reading and of interval most frequently and fully satisfies the demand?

Types of meter.—We have seen that there are two types of speech intervals which, on the basis of the criterion of regularity, may with scientific precision be called rhythmical, viz., the verse and simple centroid intervals.

As affects the simple centroid intervals, the measurements showed that the criterion of metrical perfection was most highly approached in poetry. The conditions for the highest regularity in poetry were: (1) the distribution throughout the verses of centroid intervals consisting of the same number of components; and (2) the scanning of the verses according to the routine type of scansion.

As affects the phrase intervals, the measurements showed that the criterion of metrical perfection was approached only in the verse intervals of poetry, the number of whose centroids was more limited and regular than in the sentences of prose. The conditions for securing the highest regularity, other things being equal, were: (1) limiting the duration of the intervals; and (2) subordinating the sectional to the terminal pauses, and the sectional to the terminal centroids, of the intervals.

Meter par excellence—choice of types.—Which of the two types is prior, primary or fundamental? The question is complicated. Neither type exists in isolation; both rhythms interpenetrate. A good quality of verse-interval rhythm will largely depend on, or perhaps demand, a smooth flow of centroids. It may also be associated with pause rhythms, sectional and terminal. Remembering these cautions, which type has, on the whole, the stronger claim?

Hints from the measurements.—These indicated that the range of irregularity was about $2\frac{1}{2}$ times larger, the average irregularity over 2 times larger, and the number of records of unrhythymical intervals about 4 times more for the simple intervals. In only one record was the variation of the intervals less for the simple centroid. From the point of view of regularity, experiment uniformly emphasizes the importance of the verse interval type.

This type, however, to become a rhythmic unity requires a sort of "verse" centroid, as distinguished from the "foot" centroids, at the beginning or the end. The complicated relations of the verse and foot centroids give rise to a hegemony of centroids. The verse as a rhythmical whole might be changed by eliminating the sectional and especially the terminal centroids. It could remain a regular, yet not rhythmical, group.

Hints from the test.—The grouping of the sounds into visible verses produced a delusion: spontaneous, unsuspecting thought did not distinguish verse sequences from sentence sequences. With words arranged like prose sentences the verses were pronounced non-rhythmical sentences of prose. With words arranged like verses the prose sentences were declared rhythmical, and to be poetry.

In these judgments the smoothness or rhythm of the word flow was a factor. The determining factor was the form of print, or a felt verse meter. Some who read the Tennyson verses as prose pronounced them rugged but still poetry, because of a felt verse interval rhythm. The appeal to unsuspecting thought also shows the importance of this form of rhythm.

Hints from the poet.—The following questions, bearing also on other aspects of the metrical problem, were submitted.

Questionnaire on the art of versification in respect to meter.

Describe the attitude which you assume, in the act of poetical production, toward the versification of the poem that you are about to write.

(I.) (a) Do you determine in advance the particular kind of meter which you intend to follow? (b) Do you decide that a given poem shall consist of a certain kind and number of measures—dactyls, spondees, iambi, anapests, etc.—to the line? (c) If so, do you go over your verses to see that they invariably follow the metrical system adopted? (d) Or are there forces unconsciously operative preventing any deviation from a chosen norm?

Or do you predetermine the number of emphatic or accented syllables, *i. e.*, stress-points, irrespective of the number of unaccented or weak syllables, for the verses of your poem?

(II.) Or, on the other hand, is the measure in your poetry a subordinate factor? Does it sustain a relation to special moods and emotions and to the character of the

thought which you would express? Do you become so inspired by the thought to be expressed that the form never for a moment rises consciously before you? Your foot-scheme would thus be the result of a species of unconscious cerebration, and you would become aware of its character not before, but either in the very act of poetical creativeness, or upon subsequent examination of your completed product.

(III.) Do you feel a demand for meter? Whence does it spring?

(IV.) If you employ both methods, what relation do they sustain in reference to (a) frequency; (b) ease or naturalness, and (c) results, metrical and poetical?

The meter of Christabel, it may here be noted, was founded on the principle of "counting in each line the accents and not the syllables."¹ Each verse contains four accents; the number of syllables may vary from seven to twelve. Tennyson's lyric, "The Poet's Mind," may be consulted.

Replies.

(English)

Ella Wheeler Wilcox: I cannot fully analyze my methods. They are not always the same. The idea comes usually first, a sentence, a word, or a thought only—like a point of light. I may carry it about for weeks—the germ of the poem—shapeless and undefined. When I take time to sit down and focus my mind upon it, the poem comes.

Sometimes I begin two or three shapes before I fix upon the style of verse; oftener I begin the poem as it remains, the lines falling into rhythm themselves.

Again, I decide upon a sonnet form, the moment the idea comes. One of my best sonnets ("A Minor Chord") came that way. I met two nurses on the street and the line "The wistful unkissed mouths of nurses" came to me. I knew it was a sonnet line, and days afterward sat down and built the sonnet to fit that line.

In talking with a very excitable man one day about single tax (that is, *listening* while he talked), he said: "No question is ever settled until it is settled right." I said, "Oh there is a poem in that," and at once sat down and wrote it—it has been used in two political campaigns by the Bryan orators.

Sometimes without any idea, a rhythm, a wordless song, goes ringing through my head. I walk to it—I work to it—and it pursues me until I find an idea to put into the measure.

At other times, without idea or measure, I settle down, knowing something will come.

— :² My own poetic mental habit is lyrical. As nearly as I can remember, each poem, or theme, or motif (as one would say in music) occurs to me almost simultaneously in both thought and form—a poetic phrase (made up of words in a certain poetic accent and diction) shapes itself in the mind. I do not realize at the moment what the meter is. I may, or may not, realize what the stanza or complete poem-form is to be. I think that most of my lyrics have occurred to me "on the road"—when moving about, going back and forth to my office, travelling, sometimes when I am reading. Sometimes a line or two will rest in my mind for years, and add other lines spontaneously; it may be in distant scenes. For instance, for years I had in my mind these lines, descriptive of the glow above New York as seen at night from the Staten Island ferry:

Lies like a lily white
On the black pool of night.

¹ COLERIDGE, Poetical Works, I 188, Aldine Edition.

² The writer wishes his name reserved.

Years afterward, while at Stratford-on-Avon for the first time, the whole poem came to me in a shape that I had never had in mind at all, so far as I know. It was not at all affected in form by the memory of Shakespeare verse forms, as might have been natural in the circumstances.

AT NIGHT.

The sky is dark, and dark the bay below
Save where the midnight city's pallid glow
 Lies like a lily white
 On the black pool of night.

O rushing steamer, hurry on thy way
Across the swirling Kills and gusty bay,
 To where the eddying tide
 Strikes hard the city's side !

For there, between the river and the sea,
Beneath that glow,—the lily's heart to me,—
 A sleeping mother mild,
 And by her breast a child !

My busy life has given me little time to build poems; hence their brevity and subjective quality. They start, with few exceptions, from a personal experience and emotion. At times in my mind a line or verse seems to sing itself (not an actual *tune* but a series of poetic accents); hardly anything at first except a sense of verbal music without words, stirred by the delight, perhaps, in something startlingly beautiful in nature.

In the volume "In Palestine" you will find a poem, "How to the Singer Comes the Song," which seems to be itself an answer to your question. After a few phrases or lines have started into being something seems to say, this is to be a poem in such or such a conventional form—blank verse, four lines with rhymes, six, a sonnet, etc.,—or else in some new form altogether, with stanzas irregular or unconventional in themselves but made regular by following succeeding stanzas all of the same form, or else with the regular irregularity of the dithyrambic form. After the form is thus established everything is bent to moulding the poem according to the conventional or sought-out, or accidental pattern. I find the line is in such a form—well then, it must be true to that form—unless with some variation that cannot be charged to carelessness, but to deliberate intention or deliberate adoption of an accidentally pleasing form. At one time—virtually the beginning of my poetical writing—I was very much stirred by the Italian sonnets, by Shakespeare's, Milton's, etc., and my poetic impulses naturally flowed into sonnet form; the seed phrase in the mind was apt to be inevitably sonnet-wise. I have written four in a day. I have no doubt that while Dante was writing his trilogy his poetical thought fell naturally into the terza rima.

I think the initial thought is generally a *line*; rhymes usually follow with lightning speed. I believe this is because my mind—like the minds of all moderns—is full of the music of rhymes. If I had been an ancient Hebrew, or a verse-maker of some other primitive race in the early days, the music in my mind would doubtless have been rhyme, less—would have fallen with apparent spontaneity into the forms prevalent in the language of the time.

— — — :¹ (I.) I do not determine in advance the stanza forms to be used in any particular poem, unless a thought or feeling occurs to me which seems fitted for

¹ The writer wishes his name reserved.

one of the more elaborate, recognized stanza forms, like the sonnet, rondeau, Spenserian stanza, etc. In that case I enter upon the construction of it consciously. I do go over my verses to see that there are the right number of lines, that they rhyme in the right order, and I do not commonly count the number of syllables or accents in a line in composing isometric verse. The form once adopted—say the ten-syllable iambic—my ear keeps count of the syllables half-consciously in the act of composition. When the length of the line varies, however, sometimes I find that I have made a mistake—have got a line in that is a foot too short or too long—and so have to correct.

(II.) The adoption of a line as the unit of a verse-composition, is commonly the result of unconscious cerebration, I think; or rather, perhaps of unconscious imitation, my memory being full of verses of all kinds. It is with some half-remembered measure that a thought or feeling in my mind tends to associate itself, giving possibly a line or two lines which emerge definitely into consciousness. Then the end-word in this line or lines, suggests a rhyme-word and so a stanza or couplet is formed—usually in the middle of the poem that is to be. From this, by a conscious effort of construction, I build up the piece, before and after, on the norm thus established.

(III.) I do feel a demand for meter, but could not say whence it springs without theorizing about it. Certain emotions, not at the moment they are experienced, but afterwards, when recalled, seem to crave metrical expression. A few words come to me metrically arranged, and that is the nucleus of a poem if I carry the thing any further by a definite effort of will. If not, they simply drop out of memory in a day or two. I have sometimes dreamed a line or two.

(IV.) I have not noticed the relative frequency. The two methods run together and are confused in any actual piece of verse-composition.

James Riley: (I.) I know nothing of the anatomy (I will call it) of poetry. My own experience after nineteen years, writing my first poem at the age of thirty-three, is that the form strengthens and meets unconsciously the requirements of the poem, in accordance to the inner growth.

(II.) This question answers all I know of poetry. It seems to me the poet should write his moods as they come to him, and later complete or reject the work according to its worth. In my dialect poems—in the New England and Irish dialects—I have always known what I was going to write,—to a great extent before writing a line. They have generally been of actual occurrences in my life. On the other hand—and it has always been puzzling to me why it should be so—I have written a great number of stories in prose, and in them I can never find myself able to insert a single actual incident in my experience.

To show how erratic is the poetic mood as it comes to me sometimes, out of which if worked out comes a poem, I mention a poem written a year ago and which appeared in the "New England Magazine" of last May. I remember the words and thought that led to the opening lines of the poem :

"After the book is written, after its page is read,
After the soul has brought and left what to the age is wed,"—

What connection it has with the poem I am unable to tell. The lines were to me a music that led to other music, and allowing the second feeling to express itself, I began striking the words on the typewriter "over and over and over." I did it with no connection of any thought but that should in some way involve and be of life. In this way the music came first. My first writing—beginning of the poem—was with the thought

that every stanza should begin as the first, and I can see now that the thought would have been higher, if the refrain had so continued.

N. M. Nelson : In my few metrical compositions, I have never stopped to think whether I used dactyls or spondees, or counted the syllables until I had finished. I simply let my thoughts assume the form suited to their expression. When in such a mood, the metrical part is secondary to thought, but may still be in strict conformity with poetical usage.

There is certainly a necessity for meter. This may be because we unconsciously imitate poetical composition, or the mind may require meter in certain moods to express inspired thought.

E. L. Fox (Yale '02) : (I.) (a) Before beginning to write, yes; but not before the spirit and general idea of the poem are clearly defined in my mind. (b) No. (c) No. (d) Yes. The spirit of the poem generally swings itself into a suitable meter, so that choice of a meter is usually unnecessary (when writing "to order" on a subject I am not enthusiastic about, this is not true). Sometimes I hit upon a meter I like; it sticks in my mind and suddenly occurs to me as just the thing for a subject I have been thinking over for a week or so.

(II.) The measure is distinctly paramount. It sustains a close relation to the character of the thought. The last sentence applies perfectly to my experience.

(III.) Yes; from the nature of the theme and the enthusiasm which it excites.

(IV.) I employ but one method.

Paul F. Gilbert (Yale '01) : My ear tests the quality of meter. Minor defects are corrected by mechanical examination. Forces unconsciously operative prevent with some reliability any eccentricity. The number of accented syllables is predetermined, subject to modification, with little attention to specific forms of verse, the number being settled by their capability of expressing the nucleus of the poem and other favorite sentiments which may be afterwards suggested.

My moods and emotions are emphasized by the employment of a suitable verse form, but this form is not arbitrary.

The expression of spontaneous thought often runs into the channels of least resistance—usually some elementary form of verse. The demand for meter arises from a natural desire for repetition. Repetition is agreeable, the abrupt disagreeable.

The practice of determining in advance the meter and the number of accented syllables tends to produce artistic results; but I find the spontaneous expression more satisfactory. The imitation of established verse forms leads to artificiality.

(Norwegian)

Wilhelm Petersen : (I.) (a) Sometimes I do determine the meter in advance, *e. g.*, when I write new words to some old melody, either from choice, or by the request of others. In such cases the song known to me in that meter has a certain influence on what I write, perhaps through mood-association.

(b) Strictly speaking, I do not think I ever determined in advance (except as above stated) any precise meter, as dactyl, spondee, iambus, anapest, etc. I do think, however, that after my thought has assumed a certain rhythm (the original poetic form, an emotion-product) I develop it in consciousness into a more regular meter, partly by choice influenced by my acquaintance with prosody and literature, partly as it may happen to fall in with the completed "motif" that is to form the basis of my poem.

(c) That depends. If I desire to make a "finished product," I follow the laws of prosody and rhetoric in detail.

(d) No, I hardly think there are. My opinion is that a person working under the influence of the soul-forces in a subconscious state, simply follows the rhythmic fall of his thought as accentuated by the underlying mood-waves, and the suitable words fall into the place demanded either by a musical force in subconsciousness, or are called forth simultaneously with the thought. The result is: accented-tone syllables and stress-points. Meter and rhyme are secondary results due to conscious effort toward art-form.

(II.) When the writer is unconscious of imitation and uninfluenced by mood-association, "measure" in poetry must be subordinate in degree and secondary in time, and is rather an art-effect than a factor. As the "motif" in original inspired production is "emotion of soul fused into thought"—eine Regung der Seele durch Gesinnung bewußt und im Gedanken fliezend gemacht—the desire for the materialization of which demands from the soul a conscious effort in language production, and as, furthermore, language follows the most rigid laws, just as lines do in painting and sculpture, I cannot quite see how there can exist any direct relation between the creative and conceiving mood and the outward art-form that the complete poetical thought finally assumes. That some relation may exist, it were rash to deny. The natural steps in the development of a poetical thought would then, it seems to me, be as follows: Underlying emotion, or inspiration, moving towards and shaping itself into a "motif" that rises through subconscious effort and determines "rhythm" or "tone-accent," and flowing into word-expression, following in the form it finally assumes, the laws of prosody as to meter, and of rhetoric as to choice of words.

(III.) Yes. It springs partly, at least, from the nature of the language used. However, language itself has been influenced by this demand, indicating that the demand for meter *may* follow from the first the steps in the above scheme of development, although not consciously sought for till the last.

(IV.) I think I have written (a) mostly without predetermined measure, (b) far more easily and naturally then, and (c) with better results, metrically and poetically.

(Swedish)

Jakob Bonggren: While sitting, walking, or, though rarely, lying down, some thought or, oftener, picture flashes into my mind, which I conclude will make a good poem. Sometimes I hear a meter or some line of poetry in connection with it, and that is the nucleus of the poem about to be begun.

(I.) If the mind only begets a thought or picture, I try to find a meter; this is usually an easy matter. I think I can *hear* what is the proper meter, so I seldom have difficulty in selecting a form. I very seldom, if ever, decide from the beginning the number of lines in the poem; it grows until it is full-grown. If I have one verse, it is easy to get all the following or preceding ones molded in the same form. I read through the poem, correcting and changing the words here and there, but very seldom the meter.

If I have a thought as a nucleus, I sometimes study out some of the strongest points and stress-words, select a meter, and work out the poem. Poems worked out in this way (from pictures or thoughts) I have found to be the best.

(II.) Whenever I am called upon to write a poem on a certain subject I slowly and carefully work it out; select a suitable meter and think out all I want to include in the poem. After handling my subject for a while, I sometimes feel warmed up, and then everything is easy. There seems to be an unconscious cerebration working along with conscious thought and will, when something worthy the name of a poem is created. The "poems" written to order I have found to be generally poor, unless I have warmed up in the act of composing.

(IV.) Answers as above (I.) and (II.).

As bearing on the present question, these statements indicate that both types of language rhythm, varying more or less with different composers, are felt, and make a demand upon the mind that conceives poetical thoughts and embodies itself in metrical language. Witness the terms: "wordless song," "poetic accents," "verbal music, without words," "measure paramount;" and "poetic phrase," "sonnet form," "verse form," "verse line singing itself," music of the lines, the line as the "unit of verse-composition," as the "initial thought," the "seed phrase," feeling that the line must be "true to its form," and "measure secondary."

Deduction.—Three lines of evidence thus uniformly emphasize the importance of the verse interval type of meter in speech rhythm. These intervals may approximate better than the centroid intervals the larger fluctuations of attention in speaking, which alone may possess the power to genuinely attune and cadence the soul. May we therefore regard them as the primary or chief type of the rhythm of speech?

It is a pleasant duty to acknowledge my obligations to the subjects, to those answering the questionnaire, and to the editor of the Studies.

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